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Abstracts 50203-52892

November 15, 1972

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  alloys V_3Si--Nb_3Al, 25:1093 (CALT-822-13)
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  (AAEC/LIB/Bib-254)

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TRIETHYLENETETRAMINE
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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

50203 ABSTRACTS OF PAPERS. 164th National Meeting of the American Chemical Society, New York, August 27–September 1, 1972. Washington, D. C.; American Chemical Society (1972). 683p. $6.00. (CONF-720821–(Absts.)).

Analytical Chemistry

Refer also to abstracts 50652, 50653, 50656–50658, 50713, 50746, 50747, 50754, 50778, and 51038.

50204 (AECL–4204) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, JANUARY 1 TO MARCH 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1972. 115p. (PR-CMa–20). Dep. NTIS (U. S. Sales Only). AECL $2.00.

50205 (BNWL–1651(Pt.2), pp 33-7) RADIOANALYTICAL PROCEDURE DEVELOPMENT. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

Radiochemical separation procedures that are compatible with and augment advanced instrumental analysis technology are required to provide a complete quantitative analysis of a radionuclide mixture. Although some of the developed methods are designed to separate a specific radionuclide, the major effort is directed toward group separation procedures. (auth)

50206 (BNWL–1651(Pt.2), pp 50-68) RADIATION INSTRUMENTATION: RADIOLOGICAL CHEMISTRY. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The development of radiochemical instrumentation and analytical technology, their utilization in radioisotope studies of environmental samples, their application to neutron activation analysis to define stable element versus radioelement behavior, and their use in the elucidation of the routes described by natural, tracer, or waste radioisotopes in the environs are described. (auth)

50207 (JAERI-M–4663) DETERMINATION OF OXYGEN, NITROGEN, AND HYDROGEN IN ZIRCALOY-2. Hashitani, Hiroshi; Hoshino, Akira (eds.) (Japan Atomic Energy Research Inst., Tokyo). Dec 1971. 53p. (In Japanese). NTIS (U. S. Sales Only).

Analytical methods are described that were used by eleven laboratories in their investigation of problems in the determination of oxygen, nitrogen, hydrogen and carbon in Zircaloy-2. The certified values are for oxygen (0.126%, C.V. = 6.5%, n = 84), nitrogen (0.064%, C.V. = 8.0%, n = 81) and hydrogen (8.2 ± 1.1 ppM, n = 54) in a Zircaloy-2 standard reference material, JAERI-Z10, and for nitrogen in other standard reference materials, JAERI-Z8 and -Z9 (0.03% each). (TSS)

50208 OXYGEN DETERMINATION IN PURE ALUMINUM AND IN ALUMINUM ALLOYS. Sulzberger, R. (Aluminium-Industrie AG, Neuhausen, Switzerland). Erzmetall; 24: No. 3, 123-5(1971). (In German).

Some of the basic difficulties encountered in the determination of oxygen in aluminium, as compared to steel, are set forth. A brief outline is presented of the development of the various methods, from oxide isolation via T-autoradiography up to neutron activation. Some of the most important procedures presently used are characterized and evaluated. Ring analyses show good agreement of results obtained by the various laboratories. (GF)

50209 SESIONES QUIMICAS ARGENTINAS, SAN LUIS, ARGENTINA, 12 NOV. 1970. (Argentine Chemical Meeting, San Luis, Argentina, 12 Nov. 1970). Buenos Aires; Asociacion Quimica Argentina (1970). 307p. (CONF-701152–(Absts.)).

Activation and Nuclear Reaction Procedures

Refer also to abstracts 50435, 50609, and 50788.

50210 (AEC-tr–7138, pp 84-8) CALCULATION OF OPTIMUM TIMES IN ACTIVATION ANALYSIS. Ivanov, I. N.; Filippov, V. V.; Shtan, A. S. Translated from Radiats. Tekh.; No. 3, (1969).

The problem of selection of optimum times was solved by compiling a program that can be used to determine the optimum times of irradiation, cooling, and recording the induced activity for any number of isotopes, regardless of the complexity of the system. Equations are given and a program for the BESM-3M computer is shown. (M.C.G.)

50211 (AEC-tr–7138, pp 170-6) ACTIVATION ANALYSIS FOR THE DETERMINATION OF OXYGEN IN METALS, USING NEUTRON GENERATORS WITH SEALED-OFF TUBES. Nikolaenko, K.; Shtan, A. S. Translated from Radiats. Tekh.; No. 3, (1969).

Complete automation is possible for determination of oxygen in metals by neutron activation. Use of a neutron pulse generator with a sealed-off tube was investigated as a means of improving the sensitivity and accuracy of the determination. Main components of the system are a neutron generator, a pneumatic transport line, a standard-monitor system, and a system for detecting the γ radiation. Results are given for analyses of Cu, Ti, and Pb. (M.C.G.)

50212 (AEC-tr–7138, pp 177-81) NEUTRON METHOD FOR THE DETERMINATION OF INDIUM AND CADMIUM CONCENTRATIONS IN A FLOWING SOLUTION. Kartashev, E. R.; Shtan, A. S. Translated from Radiats. Tekh.; No. 3, (1969).

Because of the large thermal-neutron activation cross section of indium and the exceptionally high thermal-neutron absorption cross section of cadmium, concentrations of the above elements can be determined by neutron activation and neutron absorption methods, respectively. An automatic apparatus was developed for the continuous, simultaneous determination of cadmium and indium in solutions under industrial conditions. The neutron-absorption method can be used to determine cadmium concentrations between 5 and 20 g/l with fair accuracy (the mean relative error did not exceed ± 5%). There was more interference in neutron activation determination of indium. (M.C.G.)

50213 (AEC-tr–7138, pp 246-60) PNEUMATIC TRANSPORT SYSTEMS FOR ACTIVATION ANALYSIS (A REVIEW). Egolin, Ya. G.; Kulichenkov, A. A.; Mamikonyan, S. V.; Mamonov, E. I. Translated from Radiats. Tekh.; No. 3, (1969).

Pneumatic transport systems consist of pneumatic conduits as well as control units and mechanisms, which govern the transportation of samples (packaged in ampoules) via the pneumatic conduits. Schematic diagrams of some systems are included and characteristics of the system are listed. (M.C.G.)

50214 (AED-CONF–71-100-45) NEW DEVELOPMENT OF ANALYTICAL METHODS BY RADIATION IN AGRICULTURE. Glubrecht, H.; Kuehn, W. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Hanover (West Germany). Institut fuer Strahlenbotanik). [nd]. 13p. (CONF-710901–542). Dep. NTIS (U. S. Sales Only).

From fourth international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

A method is described for measuring the inhomogeneity of water content in arid and semiarid soils that consisted in bringing a capillary porous probe into the soil and checking the uptake or discharge of water by continuous control of the probe's density by means of γ ray absorption. The use of activable tracers in the field of agriculture is also discussed. (D.H.M.)

50215 (BNWL-1651(Pt.2), pp 87-94) NUCLEAR TECHNIQUES IN MEDICAL SCIENCE. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II; Part 2.

Research in the application of nuclear technology and radioisotopes to the fields of medicine and biology is discussed. Advanced instrumentation concepts, detectors, and circuitry are developed for use in the fields of health physics and environmental studies. (auth)

50216 (CONF-720920-1) DETERMINATION OF MINOR ELEMENTS IN SOIL PROFILES BY NEUTRON ACTIVATION ANALYSIS. Bate, L. C. (Oak Ridge National Lab., Tenn.). [nd]. 14p. Dep. NTIS.

From 2nd international conference on forensic activation analysis; Glasgow, Scotland (27 Sep 1972).

Minor elements in soil in abundances of a few percent or less were determined by neutron activation analysis. Distributions of the elements in various soil samples are shown. (M.C.G.)

50217 (CONF-721010-1) ACTIVATION ANALYSIS OF TRACES WITH VERY HIGH NEUTRON FLUX AND WITH 140-MeV ELECTRON BREMSSTRAHLUNG. Ricci, Enzo (Oak Ridge National Lab., Tenn.). [nd]. 11p. Dep. NTIS.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Two unique "rabbit" facilities were recently installed at ORNL; the neutron activation analysis system at the High Flux Isotope Reactor (HFIR), and the photon (and fast-neutron) activation analysis facility at the Oak Ridge Electron Linear Accelerator (ORELA). A salient feature of the HFIR irradiation site is a thermal neutron flux of 5×10^{14} cm^{-2} sec^{-1}. In turn, the ORELA facility provides for simultaneous bombardment of samples and standards with bremsstrahlung photons or fast neutrons from a 140 MeV, 30 KW electron beam. Results obtained at these facilities are discussed while their main features are described. (auth)

50218 14-MeV NEUTRON ACTIVATION ANALYSIS OF BORON IN Mo-Hf SAMPLES. Hille, P.; Stengl, G.; Wolf, P. (Institut fuer Radiumforschung und Kernphysik, Vienna). Materialpruefung; 14: No. 5, 147-50(1972). (In German).

A new procedure for the determination of boron concentrations below 500 ppM in Mo-Hf samples is described. A short-lived radioisotope ^{8}Li is produced by activation with 14 MeV neutrons using the nuclear reaction ^{11}B(n,α)^{8}Li. The active samples are shot to the measurement position by a fast, automatic pneumatic tube system. The 13 MeV β radiation of ^{8}Li is measured with a plastic scintillation detector. The calibration of the detector efficiency is of special importance. (GF)

50219 REMOVAL OF INORGANIC IONS FROM SOLUTIONS WITH FIBROUS ION-EXCHANGE CELLULOSE AND CHECKING OF THE PURIFIED SUBSTANCES BY NEUTRON-ACTIVATION ANALYSIS. Remport-Horvath, Zs.; Oerdoegh, M. (Lorand Eoetvoes Univ., Budapest). Mikrochim. Acta; No. 4, 491-5 (1972).

For the rapid removal of heavy metal impurities such as Cu, Zn, Fe, Na, and Co from large volumes of solutions, ion-exchange cellulose loose fibres proved to be effective. Distilled water and absolute ethanol were purified by the column technique. For checking the effectiveness of the purification analysis using carboxycellulose and neutron activation were used. The results were in good agreement. The purification is effective up to ppt concentrations. (auth)

50220 ACTIVATION ANALYSIS OF HUMAN HEAD HAIR. 3. ACTIVATION ANALYSIS OF HAIR BY SHORT-TIME IRRADIATION. Kozuka, Hiroshi (National Research Inst. of Police Science, Tokyo); Tsunoda, Noriko; Isono, Hideo; Niwase, Takeshi. Eisei Kagaku; 17: No. 4, 270-3(Aug 1971). (In Japanese).

Hair samples were analyzed by short time irradiation with neutrons using pneumatic tube for the purpose of increasing detectable elements and of establishing a rapid method of analysis in a practical case. Spectra of short-life nuclides of hair samples from different donors were sufficiently characteristic and distinguished from each other. Main detectable elements were Al, Br, Cl, Mn, and Na, and sometimes I, Se, Ti, and Zn were detected. Determination of Al and Cl was possible by a short irradiation. Their complex spectra could be analyzed by the stripping method. As a polyethylene sheet contains a markedly large quantity of Ar and other elements which disturb the determination of components in samples, its use in nondestructive activation analysis must be reconsidered. (auth)

50221 NEW METHOD OF DETERMINATION FOR THE TRACE RUTHENIUM IN HIGH-PURITY PALLADIUM BY NEUTRON ACTIVATION ANALYSIS. Lee, Chul; Yim, Yung Chang; Uhm, Kyung Ja; Chung, Koo Soon. Daehan Hwahak Hwoejee; 15: No. 4, 191-7(1971).

Ruthenium content in highly purified palladium metal (99.9%) was determined by counting ^{105}Rh nuclide which was produced by ^{104}Ru (n,r;β^-) ^{105}Rh nuclear reaction. Palladium sample and ruthenium standard were irradiated by neutron with the Pneumatic Transfer System of TRIGA MARK II reactor. Palladium and ruthenium were dissolved by treating with aqua-regia and by fusing with sodium peroxide flux respectively. ^{105}Rh was separated through anion and cation exchange resin columns. The ruthenium content was determined by comparing the ^{105}Rh activities, obtained from the palladium sample, with that from pure ruthenium standard. The detection limit of ruthenium by the present method is about 1 ppM of ruthenium in 10 mg of palladium, which is approximately 40 times more sensitive than that of the conventional radioactivation method which employs ^{102}Ru(n,r)^{103}Ru nuclear reaction. (auth)

50222 NEUTRON ACTIVATION ANALYSIS OF ANCIENT BURMESE SILVER COINS WITH A LOW FLUX AMERICIUM/BERYLLIUM NEUTRON SOURCE. Thiele, R. W.; Aung Khin, U.; Kyaw, U. (United Nations Development Programme, Monrovia, Liberia). Archaeometry; 14: No. 2, 199-219(Aug 1972).

A simple method of neutron activation using isotopic neutron sources for the determination of the silver, copper, and gold content in silver coins based on the self-shielding properties of silver alloys of different fineness is described. The method was found to be useful for the quick routine assay of silver coins for the purpose of their classification. Seventeen ancient Burmese silver coins from three different cultural periods of Burma, and two British coins for comparison were analyzed by this method. (auth)

50223 RADIOACTIVE INVESTIGATION OF THE EFFECT OF THERMAL TREATMENT ON THE MANGANESE CONTENT IN BIOLOGICAL MATERIAL. Abdullaev, Ya. S.; Khatamov, Sh.; Kist, A. A. Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 47-9(1971). (In Russian).

The change in Mn content in mulberry leaves processed at various temperatures was measured with the help of neutron activation of weighed portions of the ashed material in a flux of 10^{12} n/sec · cm^2 for a period of 1 to 10 min. The γ spectrum identified ^{56}Mn with the line 0.845 MeV. The concentration of Mn gradually decreased as the ashing temperature was raised from 100° to 1,100°C. The time of incineration was also evaluated as a function of temperature. (K.S.W.)

50224 NONDESTRUCTIVE DETERMINATION OF TUNGSTEN WITH Be-D NEUTRON ACTIVATION ANALYSIS USING BROMINE AS INTERNAL STANDARD. Jinno, Kiyokatsu; Ishii, Daido (Nagoya Univ., Japan). Nippon Kagaku Kaishi; No. 7, 1241-4 (Jul 1972). (In Japanese).

A nondestructive fast neutron activation method for the determination of tungsten in various compounds is described. The short-lived ^{183m}W formed by the process ^{183}W(n,n′)^{183m}W proved to be satisfactory for this method. The lowering of its precision due to possible variations in experimental conditions, especially to the fluctuation of the neutron flux during the irradiation, has been found to be minimized by the use of bromine as an internal standard material. Since the half-life of ^{79m}Br formed by the process ^{79}Br(n,n′)^{79m}Br is almost the same as that of ^{183m}W, the induced activities of both of these nuclides can be regarded as proportional regardless of the experimental conditions. In the five-cycle irradiation method, a straight line was obtained as a calibration curve for tungsten contents from 50 to 200 mg, with a relative error of less than 2.0%. (auth)

50225 NEUTRON ACTIVATION ANALYSIS IN SCIENTIFIC CRIME INVESTIGATION. Guinn, Vincent P. (Univ. of California, Irvine). Isotop. Radiat. Technol.; 9: No. 4, 379-84(1972).

The literature is reviewed on applications of neutron activation analysis in forensic investigations. (auth) (91 references)

50226 ACTIVATION ANALYSIS PROGRAM AT GULF RADIATION TECHNOLOGY: THE FIRST DECADE. Lukens, H. R. (Gulf Radiation Tech., San Diego, Calif.). Isotop. Radiat. Technol.; 9: No. 4, 393-6(1972).

Some of the areas encountered by the Activation Analysis Group at Gulf Radiation Technology during the last ten years are discussed including criminalistics, oil-spill identification, biological tissue analysis, very short-lived isotopes, Bremsstrahlung activation, delayed neutron activation analysis, and computerization. (D.H.M.)

50227 NEUTRON ACTIVATION METHOD OF DETERMINING TRACE IMPURITIES OF Au, Cu, AND Zn IN MERCURY TELLURIDE AND IN THE TERNARY COMPOUND $Cd_xHg_{1-x}Te$. Bocharova, N. N.; Razumova, G. N.; Shuba, I. D. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 165-6(1972).

Translated from Radiokhimiya; 14: No. 1, 158-9(1972).

Precipitation first with hydrazine, then with tin chloride is used, as a result of which the basic components of the sample are separated. The problem of the analysis is then reduced to a determination of gold in the presence of tellurium, copper in the presence of mercury, and zinc in the presence of cadmium. The maximum sensitivity of the determination from a 0.2g sample of $Cd_xHg_{1-x}Te$ or HgTe is: Au, 8.6×10^{-11}g; Cu, 3.4×10^{-10}g; and Zn, 4.5×10^{-9}g. (M.C.G.)

50228 AUTORADIOGRAPHIC VARIANT OF ACTIVATION ANALYSIS FOR INVESTIGATION OF IMPURITY SOLUBILITY IN SEMICONDUCTORS. Yuldashev, G. F.; Usmanova, M. M.; Vodakov, Yu. A. At. Eneerg. (USSR); 33: No. 1, 592-3(Jul 1972). (In Russian).

Experiments were conducted in order to determine the solubility of Sc, Y, Cr, and several rare earth elements in samples of silicon carbide grown from solution-melts by zone melting, and Ga in epitaxial SiC films prepared by sublimation. Samples were irradiated in a flux of 1.8×10^{13} n/cm^2 · sec for periods of from 10 to 100 hr depending on the element being determined, and then 30 hr later the irradiated samples were etched with $HF-HNO_3$. The alloying impurities were determined with a gamma spectrometer. Distribution of the impurities through the sample was ascertained by means of an autoradiogram, placing the sample in contact with photographic film. The solubility of Sc, for example, was thus found to be 3×10^{17} atoms/cm^3 as judged by the uniformly blackened areas of the film. (K.S.W.)

50229 DETERMINATION OF THORIUM IN BOVINE BONE BY NEUTRON-ACTIVATION ANALYSIS. Ohno, S.; Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan). Analyst; 97: No. 1157, 605-8(Aug 1972).

Thorium is determined in bovine bone by neutron activation analysis. A radiochemical procedure is described in which protactinium-233 resulting from the reaction $^{232}Th(n,\gamma)^{233}Th \xrightarrow{\beta\text{-decay}} {}^{233}Pa$ is extracted with trioctylamine in xylene and subsequently back-extracted with distilled water, following collection of the thorium in the bone by Korkisch's (Analyt. Chem. 33, 1264, 1961) anion-exchange method and irradiation. The protactinium-233 activity is measured by γ spectrometry. The precision of the method is better than ±15% for samples with a thorium content exceeding 0.0037 ppM. (auth)

50230 DETERMINATION OF TRACE (PARTS PER 10^9) AMOUNTS OF GOLD IN PLANTS BY NON-DESTRUCTIVE ACTIVATION ANALYSIS. 3. SOCIETY FOR ANALYTICAL CHEMISTRY CONFERENCE. Schiller, P.; Cook, G. B.; Kitzinger, A.; Woelfl, E. (International Atomic Energy Agency, Seibersdorf, Austria). Analyst; 97: No. 1157, 601-4(Aug 1972).

A non-destructive activation analysis method for the routine determination of trace amounts (parts per 10^9) of gold in the ashes of various plant materials, grass, and maize was developed. The homogeneity of the gold distribution in the samples is of particular importance and several different methods of sample preparation were studied. The lower limit for the determination of gold is below 1 part per 10^9, calculated for dried plant material. The method was developed for a geochemical research program and permits the determination of submicrogram amounts of gold in plants to be carried out more simply than do techniques that involve chemical separation. (auth)

50231 CHEMICAL AND MICROPROBE INVESTIGATIONS OF THE ALLENDE-METEORITE. Malissa, H.; Hermann, F.; Kluger, F.; Kiesl, W. (Univ., Vienna). Mikrochim. Acta; No. 3, 434-50(1972).

Results of chemical and radiochemical bulk analysis of main, minor, and trace elements in the Allende meteorite are, with the exception of Hg, in good agreement with respect to mean values characteristic for C III chondrites. Mineralogical and petrographical investigation shows three distinct components: chondrules and irregular white aggregates embedded in a fine-grained black matrix. Electron microprobe analyses were performed on silicate, metal, sulfide, and oxide grains. The chondrules consist mainly of Mg-rich olivine, furthermore of clinoenstatite, anorthite, Ca—Al-rich glass and minute amounts of metal and sulfide. Marked features are the separation of metal into kamacite and taenite, the presence of awaruite- (~Ni_3Fe), and of taenite-grains which are surrounded by a goethitelike oxide. The white aggregates are a fine grained agglomeration of Ca—Al-rich minerals, e.g., spinel, augite, gehlenite, anorthite, and diopside. Information about the composition of matrix was obtained by analysis using a defocused electron beam. Neutron activation and γ spectrometry were used for the determination of trace amounts of Se, As, Sb, Sn, Re, Hg, Au, Mo, Os, Ru, Zn, In, Ir, Sc, Rb, and Cs. (auth)

50232 MOLYBDENUM-COMPLEX EQUILIBRIA FOR LIQUID—LIQUID EXTRACTION. D'Olieslager, W.; D'Hont, M. (Univ., Leuven, Belg.). J. Nucl. Mater.; 44: 185-93(1972).

After a comparative study of methods of determining molybdenum in fission-product solutions, a study was undertaken of the equilibria of a series of fission products in several acid solution systems. From the data a structure of the molybdenum complex in acetylacetone media was derived. The results further lead to a separation procedure for molybdenum based on reversed-phase partition chromatography in TBP on kieselghur followed by liquid-liquid extraction from a 3M sulfuric acid solution into acetylacetone in chloroform. The resulting scheme proves to be very selective and consequently useful for burnup determination of fast reactor fuels. (auth)

50233 ACTIVATION ANALYSIS IN ENVIRONMENTAL POLLUTION STUDIES INCLUDING Hg, Pb, AND PESTICIDES. Guinn, V. P. (Univ. of California, Irvine). Radioisotopes (Tokyo); 20: No. 11, 612-19(Nov 1971). (In Japanese).

The application of neutron activation analysis (NAA) to the studies of pollution of air, rivers, and food is reviewed. Fallout was collected near a power plant and irradiated by thermal neutrons from the Triga Mark I furnace at 2.5×10^{12} n/cm^2 sec for a minute. Measurement with a NaI(Tl) crystal/400-channel γ spectrometer indicated that main radioactivity was due to ^{52}V, which gave a high peak at 1.434 MeV. Thus the source of the air pollution was confirmed to be V_2O_5 exhausted from the power plant. Lead exhausted by automobiles is easily determined by NAA. Pollution of water is a good object of the study by NAA, because water itself is not activated by the irradiation with thermal neutrons; Cr, Cu, As, Cd, and Hg were main objects of study. Contents of Na, V, Mn, Co, Cu, Zn, As, and Sb in fuel oil for ships vary in a wide range. For example, the content of V varies within a ratio of 1:228 and that of Na in a ratio of 1:300. This variation in the ratios is valid for determination of the origin of pollution of seawater by discharge of oil from ships. Br and Hg in foods are also good objects of determination by NAA. (FUKUTOMI, T.) (Japan)

Chemical and Spectral Procedures

Refer also to abstract 52629.

50234 (IS-T-541) GAS CHROMATOGRAPHIC DETERMINATION OF LANTHANIDE MIXED-LIGAND COMPLEXES OF 1,1,1,2,2,6,6,7,7,7-DECAFLUORO-3,5-HEPTANEDIONE. Burgett, Charles Allen (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 152p. Dep. NTIS.

Thesis.

The fluorinated β-diketone 1,1,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione when used in combination with organic neutral donors such as di-n-butyl sulfoxide and tri-n-butyl phosphate forms volatile complexes of the lanthanides. The mixed-ligand complexes are prepared by synergistic extraction of aqueous solutions. The complexes can be determined directly by sampling the organic phase of the extraction mixture and subsequent gas chromatographic analysis. A gas chromatographic method is reported for the separation and quantitative determination of the lanthanides as mixed-ligand complexes. Using the β-diketone 1,1,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione and the neutral donor di-n-butyl sulfoxide to form the complexes, the lanthanides can be separated and quantitatively determined in the concentration range of 0.2 to 15 μg metal with a relative error of less than 8%. The solvent extraction system effectively eliminates interference from thorium(IV), uranium(VI), aluminum, iron(III), and calcium and enables rapid quantitative preparation of the chelates. Several column phenomena were observed when the silicon polymer liquid-phases SE-30 and QF-1 were used as immobile liquids. The nature of partitioning with these liquid phases is described. Column phenomena were investigated in detail and found to be directly related to liquid phase type and concentration. The liquid phase Dexsil 300 GC is shown to possess optimum properties for use in determination of the lanthanides and is void of the nonideal column phenomena observed with other liquid phases. The electron-capture detector was investigated and reported to be extremely sensitive to the mixed-ligand complexes. Because of column adsorption the use of the electron-capture detector is precluded. (auth)

50235 (LA-4971) DETERMINATION OF OXYGEN IN IRRADIATED REACTOR FUELS AND CLADDING MATERIALS.

MacDougall, Carolyn S.; Smith, Maynard E.; Waterbury, Glenn R. (Los Alamos Scientific Lab., N. Mex.). Aug 1972. Contract W-7405-eng-36. 8p. Dep. NTIS.

A method for determining oxygen was adapted and remotized for analysis of irradiated fuels and claddings in a hot cell. The sample is reacted with carbon at 2000°C to liberate oxygen as carbon monoxide and dioxide, which are measured gravimetrically or manometrically, depending on their quantities. Oxide fuels are mixed with graphite and pressed into pellets before the reaction. The evolved carbon dioxide is absorbed on Ascarite and weighed, and the carbon monoxide is oxidized over copper oxide to carbon dioxide before being trapped and weighed. The oxygen content is calculated from the weight increases of the two tubes. Analyses of 1-g samples of oxide fuels that had undergone 6.5 and 8.5 at. % burnup showed that the relative standard deviation of the method is 0.4%. Carbide fuel and cladding samples, which have low oxygen contents, generate only carbon monoxide when heated to 2000°C in a graphite crucible containing platinum. The carbon monoxide is oxidized by Schütze reagent to carbon dioxide, which is collected in a capillary trap and measured manometrically. The relative standard deviation of this method is 10% in the analysis of 100-mg samples of carbide fuel or cladding. (auth)

50236 RAPID METHOD FOR CONCENTRATION AND DETERMINATION OF MICRO-AMOUNTS OF METAL IONS USING TWO-STEP FLOW-COULOMETRY. Kihara, Sorin (Japan Atomic Energy Research Inst., Tokai); Motojima, Kenji; Fujinaga, Taitiro. Jap. Anal.; 21: No. 7, 883-90(Jul 1972). (In Japanese).

A rapid method for concentration, separation, and determination of various metal ions using two-step flow-coulometry was developed. Carbon fiber is used for the working electrode. The supporting electrolyte solution (0.5 M perchloric acid) is passed through the flow-coulometric column electrode. The working electrode potential of the first step (E-I) and the second step (E-II) column electrodes is adjusted to sufficiently negative potential (e.g., −1.40 V vs. mercurous sulfate electrode, MSE) for electrodeposition of various metal ions (e.g, cadmium, thallium, lead, copper). Some 10^{-7} moles of metal ions are injected and electrodeposited near the inlet of E-I. Then, the electrode potential of E-I is changed to a more positive potential to oxidize the most easily oxidizable metal (e.g., −1.180 V vs. MSE for cadmium). The metal ion is eluted from E-I and flowed into E-II and electrodeposited there. The quantity of electricity for the electrodeposition at E-II corresponds to the amount of the metal ion. Other metal ions are separated and determined by similar procedures. Microamounts (2×10^{-7} moles) of cadmium, lead and copper ions were concentrated and determined from 10 l of aqueous solution containing 10^{-3} M uranium. The flow-rate of supporting electrolyte is controlled to 10 ml/min for concentration and 2 ml/min for separation and determination. (auth)

50237 MICRODETERMINATION OF RUTHENIUM(III) IN PRESENCE OF OTHER METALS. Chawla, R. S.; Singh, R. P. (Univ. of Delhi). Mikrochim. Acta; No. 4, 496-502(1972).

Ruthenium(III) reacts with thiovioluric acid in aqueous medium at pH 4.45 to 6.00 to yield a pinkish-violet complex with absorption maximum at 540 nm. Full color development requires heating for about 30 minutes on a boiling water bath. The system obeys Beer's law in the range 0 to 5.6 ppM of ruthenium. The sensitivity of the reaction is 0.0046 μg/cm^2 (for log 10/I = 0.001) at 540 nm. The composition of the complex is 1 : 2, as shown by Job's and Bent and French methods. The effect of various foreign ions in the determination of ruthenium was also investigated. (auth)

50238 AAS-DETERMINATION OF IRON, NICKEL, COBALT, MANGANESE, AND CHROMIUM IN TUNGSTEN AND MOLYBDENUM. Neumann, G. M. (OSRAM-Studiengesellschaft, Munich). Z. Anal. Chem.; 259: No. 5, 337-43(1972). (In German).

Results of the atomic-absorption behavior of several metals (Fe, Ni, Co, Mn, Cr) in tungsten and in molybdenum are reported. No mutual interference of these elements was observed. Furthermore the influence of dope-elements, such as alkali, calcium, aluminum, or silicon, was investigated. AAS can be applied without prior separation for determination of Fe, Co, Ni, Mn, and Cr in tungsten and in molybdenum. The sensitivity found was in the range 0.10 to 0.30 μg/ml or 5 to 20 ppM in the solid material, respectively. (auth)

50239 SELECTIVE AMPEROMETRIC TITRATION OF MOLYBDENUM WITH OXINE IN PRESENCE OF DCTA. Christova, R.; Lihareva, N. (Univ. of Sofia). Z. Anal. Chem.; 259: No. 5, 348-51(1972).

In the presence of DCTA (diaminocyclohexanetetraacetic acid) molybdenum is selectively precipitated with oxine (8-quinolinol). The precipitation may be utilized for a volumetric determination with amperometric end-point detection. The influence of the ions that usually accompany molybdenum was established from the values obtained for the conditional solubility products of their oxinates. The behavior of Cu(II), Fe(III), W(VI), and Al(III) was studied experimentally. It is shown, that Cu, Fe and W are completely masked by DCTA, Al was masked with NH_4F. Current results are obtained with Mo concentrations in the initial solution $>1 \times 10^{-5}$ and $\leq 1 \times 10^{-3}$ M. The standard deviation of the method amounts to ±0.02 mg, while the relative (%) standard deviation varies within 0.2 to 2.0. (auth)

50240 DETERMINATION OF MICROGRAM QUANTITIES OF TUNGSTEN IN IRON, MOLYBDENUM, AND TITANIUM BY X-RAY FLUORESCENCE ANALYSIS. Maeda, Fujio; Hayasaka, Toyoo (Tohoku Univ., Sendai). Sci. Rep. Res. Inst., Tohoku Univ., Ser. A; 23: No. 3-4, 118-26(Feb 1972).

Tungsten is precipitated using phenylfluorone with germanium as a coprecipitant. The precipitate is filtered through a cela or membrane filter, and submitted to x-ray fluoroscence analysis. Molybdenum and titanium were masked with EDTA and hydrogen peroxide respectively, and 1% sulfuric or hydrochloric acid was suitable for formation of the precipitate. The method was found to be more rapid and more highly sensitive compared to chemical or fluorescent spectral methods and precision. Reproducibility of this method was about 3% in coefficient of variation for iron, molybdenum, and titanium. (auth) (Japan)

50241 EFFECT OF CsCl-GRAPHITE BUFFER ON THE PROPERTIES OF A DC ARC IN THE EMISSION-SPECTROMETRIC ANALYSIS OF NEODYMIUM OXIDE. Osumi, Yasuaki; Miyake, Yoshizo (Government Industrial Research Inst., Osaka). Z. Anal. Chem.; 260: No. 2, 97-101(1972).

The effects of CsCl–graphite buffer on the properties of a dc arc in the emission-spectrometric determination of traces of rare earth elements in neodymium oxide were investigated by measuring the line intensity, arc temperature, electron density, atomic concentration, and residence time of rare earth particles in the arc plasma. The buffer gives a constant rate of evaporation of rare earth elements, as well as greater volatility of the sample and causes the increase of the number of atoms in the arc plasma. The atoms and ions of rare earths distribute uniformly along the axis of the discharge gap. These enhancing effects are interpreted by the decrease of the ionization degree of rare earths with increasing electron density, and by the increase of the residence time of the atoms and ions of rare earths in the arc plasma. The buffer enhances the sensitivity and reproducibility and permits the determination of microquantities of rare earth elements with limits of detection from 2 to 9 ppM in neodymium oxide. The coefficients of variation are less than 14%. (auth)

50242 SPECTROGRAPHIC ESTIMATION OF IMPURITIES IN SELENIUM. Joshi, B. D.; Bangia, T. R.; Dalvi, A. G. I. (Bhabha Atomic Research Centre, Trombay, India). Z. Anal. Chem.; 260: No. 2, 107-10(1972).

An emission spectrographic method for estimation of impurities of Al, As, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn, Mo, Ni, Pb, Sb, Sn, Te, Ti, V, Zn, and Zr in high-purity selenium at concentrations less than 1 ppM was developed. The impurities were separated from 1 g of selenium by volatilizing Se from its solution in nitric acid and sulfuric acid. The residue containing impurities was dissolved in small amounts of 6M HCl and loaded along with the washing on a 10-mg mixture containing graphite (90%) and sodium chloride carrier (10%), in the electrode crater. The spectra were excited in a dc arc carrying 13 A. The detection limits lie in the range 0.005 to 0.5 ppM for the different elements. The precision of the method ranges from 7 to 18% for these elements. (auth)

50243 LUMINESCENT TITRIMETRIC MICROMETHOD FOR THORIUM DETERMINATION. Stolyarov, K. P.; Grigor'ev, N. N.; Solov'ev, L. A. Vestn. Leningrad. Univ., No. 4, Fiz., Khim.; No. 1, 130-4(Feb 1972). (In Russian).

Conditions for the luminescent microtitration of the thorium-morin complex with solutions of oxalic acid and selection B for pH 1.5 to 3.0 were studied. The sensitivity of the titration is 1 μg of Th in 2 ml of the solution. The method permits determining 1 to 40 μg of Th/2 ml during the titration by solutions of oxalic acid and 1 to 100 μg of Th/2 ml during the titration by solutions of selection B. One hundred fold amounts of Pb and the rare earths, 500-fold amounts of Ca ions and UO_2^+, 50-fold amounts of Fe (III) ions, and also 250-fold amounts of chloride ions and arsenates do not interfere with thorium determination during the titration by solutions of selection B. Sulfate ions weaken the luminescence of thorium-morin complex considerably. (auth)

50244 APPLICATION OF THE X-RAY SPECTROPHOTOMETER TO THE SOLUTION OF VARIOUS ANALYTICAL PROBLEMS. Gurvich, Yu. M.; Bakhtiarov, A. V.; Ivanova, G. A.; (and others). Appl. Metody Rentgenovskogo Anal.; No. 7, 150-8(1970). (In Russian).

The FRS-2 spectrometer is used for determination of most elements' significance industrially. Methods for analysis of powders, alloys, and solutions for Fe, Cu, Zn, As, Se, Y, Zr, Nb, Mo, Cd, Sn, Sb, Ta, Pb, Bi, Th, and U were developed. (Selenium-Tellurium Abstr.)

50245 IS POLAROGRAPHY DEAD? Florence, T. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Proc. Roy. Aus. Chem. Inst.; 39: No. 7, 211-18 (Jul 1972).

Polarographic techniques for quantitative analysis are described. Polarography is returning to favor due to the demand for heavy metal analysis and the appearance of improved electrochemical instruments. It is a sensitive rapid technique applicable to analysis in the inorganic, organic, geochemical, biochemical, medical and pharmaceutical fields, and is probably the most versatile of all trace analysis methods. Pulse, phase sensitive a.c. and single sweep d.c. polarography can compete successfully with atomic absorption spectrophotometry for the determination of Al, As, Bi, In, Pb, Sb, Sn, Ti, Tl, V, W, U, Ge, and Zr. Polarography has no rival for the determination of electroactive organic compounds. (Australia)

50246 SEPARATION AND QUANTITATIVE DETERMINATION OF THE YTTRIUM GROUP LANTHANIDES BY GAS–LIQUID CHROMATOGRAPHY. Burgett, Charles A.; Fritz, James S. (Ames Lab., Iowa). Anal. Chem.; 44: No. 11, 1738-42(Sep 1972).

A gas chromatographic method is reported for the separation and subsequent quantitative determination of the yttrium group lanthanides. The lanthanides are synergistically extracted from aqueous solution with the polyfluorinated β-diketone 1,1,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione, (H(FHD)), as ligand, and di-n-butylsulfoxide (DBSO) as neutral donor. The composition of the extracted species is reported to be $\text{R.E.(FHD)}_3 \cdot 2\text{DBSO}$. Thermogravimetric analysis of the complexes is reported. Analytical curves were prepared and found usable through a range of 10^{-7} to 10^{-5} gram metal. Individual lanthanides were determined with 97.5% recovery with a relative mean deviation of ±1.5 pph and a relative standard deviation of ±1.9 pph. Mixtures of lanthanides were determined with 97.1% recovery with a relative mean deviation of ±2.3 pph and a relative standard deviation of ±3.1 pph (auth)

50247 GRAVIMETRIC ANALYSIS OF URANYL–ORTHOPHOSPHATE MIXTURES. Schaekers, J. M. (Atomic Energy Board, Pretoria). Anal. Chem.; 44: No. 11, 1873-6(Sep 1972).

Gravimetric methods for determining UO_2^{2+} and orthophosphate are described that are based on the precipitation of $U_2O_3P_2O_7$. The accuracy of the method for UO_2^{2+} is ±0.2% if pure nitrate solutions are used. An accuracy of ±0.4% can be obtained for orthophosphate determination with pure nitrate solutions. Deviation will be found in both determinations if chloride or sulfate ions are present unless in very small quantities. Procedures for dissolving some U–P–O compounds are also given. Almost all uranium phosphates can be dissolved in nitric acid and it is recommended that the solutions should be boiled for a short time to ensure complete conversion of U(IV) to UO_2^{2+}. UP_2O_7 cannot be dissolved in concentrated HNO_3 or in aqua regia; however, it is soluble in an equal mixture of NH_4OH and H_2O_2 especially if the mixture is gently heated. (D.H.M.)

50248 ARSENATO–IODOMETRIC DETERMINATION OF NIOBIUM. Mamedov, I. A.; Mukhin, O. S. Azerb. Khim. Zh.; No. 4, 139-42(1971). (In Russian).

A novel titrimetric method for Nb in tartrate solutions that requires about one hour was developed for the determination of 3 to 90 mg of the metal. Concentrated HNO_3 and arsenate ion were added to the test solution, heated to 70 to 80°C, and filtered. The precipitate was washed with H_2O, dissolved in hot dilute H_2SO_4 containing $NH_4C_2O_4$, and cooled. Benzene and 3N KI were added with shaking, then the whole was diluted with water, and titrated with standard thiosulfate to the disappearance of a red color in the benzene layer. A list of the noninterfering ions, including uranyl, is given; Th^{4+}, Tl^{4+}, Zr^{4+}, Hf^{4+}, and WO_4^{2-} did interfere. (K.S.W.)

50249 END-POINT INDICATION OF CHELATOMETRIC TITRATIONS BY THE DECOMPOSITION OF HYDROGEN PEROXIDE CATALYZED BY LEAD(II) AND COPPER(II). Kiss, Tibor F. A. (Univ., Novi Sad, Yugoslavia). Mikrochim. Acta; No. 3, 420-3(1972). (In German).

The application of the decomposition of hydrogen peroxide as an exothermic indicator reaction catalyzed by lead(II) and copper(II) to the thermometric endpoint detection of chelatometric titrations is described. The catalytic action of lead(II) is applied in ammonia–ammonium tartrate solution (pH 12), and the action of copper(II) in ammonium carbonate (pH 8.8), sodium hydroxide–sodium carbonate (pH 10), and in ammoniacal medium (pH 12). The direct titration of EDTA, DCTA, and NTA with copper(II) and lead(II), the inverse titration of these metals, as well as the determination of several ions (Zn^{2+}, Cd^{2+}, Cu^{2+}, Ni^{2+}, Pb^{2+}, Bi^{3+}, In^{3+}, Th^{4+}) by backtitration were studied. The ions mentioned can be determined in the milligram and in the microgram range with reasonable accuracy. (auth)

50250 CONCENTRATION OF MICROIMPURITIES BY DIRECT CRYSTALLIZATION FOR THE SPECTRAL ANALYSIS OF HIGH-PURITY TELLURIUM. Yudelevich, I. G.; Kirgintsev, A. N.; Prokhorova, S. A.; Asnina, L. L. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 14, Ser. Khim. Nauk; No. 6, 117-20(Nov 1971). (In Russian).

The extraction of impurities into the concentrated product during the direct crystallization of tellurium was studied. The crystallizational concentration enables a ten-fold increase in sensitivity of the spectral determination of gold, copper, silver, bismuth, and lead in tellurium. The errors arising in different stages of the manipulation of a sample were studied by dispersional analysis, and their contribution to the total error in the analysis is estimated. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 50663, 50686, 50745, 50779, and 51156.

50251 (AEC-tr–7138, pp 32-7) STATISTICAL ERROR IN THE MEASUREMENT OF BINARY MIXTURE CONCENTRATIONS BY RADIOISOTOPE ABSORPTION-MEASUREMENT TECHNIQUES. Kreindlin, I. I.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

Expressions are derived for the effect of concentration of the medium on the gamma flux and the determination of the absolute error of the concentration measurement. Calculations show that the error minimum lies far beyond the range of feasible cases. The relations found make it possible to select the conditions for measurements by radiometric techniques on the basis of maximum permissible error. (2 figures) (R.W.R.)

50252 (AEC-tr–7138, pp 37-40) ERRORS DUE TO NONLINEAR ABSORPTION IN THE MEASUREMENT OF LIQUID DENSITIES AND CONCENTRATIONS BY A RADIOISOTOPE METHOD. Kreindlin, I. I.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

An expression for the dependence of the radiation flux on the density of the medium is expanded in a Taylor series to find the error due to nonlinear absorption. The relation between the changes in the radiation flux and changes in density is found. The equations that enable evaluation of the error associated with the nonlinearity of radiation attenuation in density and concentration measurements are derived and graphed. The necessary corrections may be made either by introducing the corresponding nonlinearity in the scale of the measuring apparatus or by the use of a self-compensating measuring system. (1 figure) (R.W.R.)

50253 (INS-TCH–6) CHEMICAL ANALYSIS OF BERYLLIUM IN MARINE SEDIMENT FOR ^{10}Be MEASUREMENT. Inoue, T.; Sakamoto, K.; Takagi, J.; Tanaka, S. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 15 Jul 1971. 21p. (In Japanese). INIS.

Beryllium in pelagic sediment from the Pacific Ocean was analyzed by means of a solvent extraction method using beryllium-acetylacetone complex. Details of the experimental procedures are presented. The beryllium contents ranging from 1.2 to 3.3 γ/g (dry weight) were obtained for three sediment cores from the deep ocean. The major chemical compositions for three core samples are shown. The detailed chemical procedure for beryllium extraction from a large amount of a sediment sample is also presented, the purpose of which is the preparation and chemical analysis of a ^{10}Be ($T_{1/2} = 2.5 \times 10^6$ y) counting sample. An acid leaching experiment was tried on aluminum (beryllium) from a sediment sample and the selective leaching of ^{10}Be from the matrix is discussed. (auth)

50254 (KFK–1552) APPLICATION OF FISSION TRACK ETCHING PROCESS FOR DETERMINATION OF LOW-LEVEL URANIUM CONCENTRATION IN LIQUIDS AND AEROSOLS. Piesch, E.; Weng, P. S. (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1972. 19p. Dep. NTIS (U. S. Sales Only).

The technical aspects of applying the fission track etching process for rapid determination of low-level uranium concentration in liquids and aerosols are presented and discussed. The calibration procedures for both microscopical counting of etch pits with Nomarski interference contrast equipment and spark counting are given. Some experimental results are included for illustration and comparison. (auth)

50255 USE OF BACK-SCATTERING IN ELEMENTAL ANALYSIS. Anttila, A.; Kairento, A.-L.; Piiparinen, M.; Viitasalo, M.; Luomajaervi, M. (Univ. of Helsinki). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 315-20(Jul 1972).

The back-scattering of helium ions was utilized in elemental trace analysis. By using this method elements were detected simultaneously at a level of 10^{-11}g. Acceleration of He$^+$ particles was performed with a low-energy Van de Graaff-accelerator. This method was applied to the analysis of samples of different types. (auth)

50256 SPECTROCHEMICAL ANALYSIS BY X-RAY FLUORESCENCE. Mueller, R. O. London; Adam Hilger Ltd. (1972). 326p.

Translation of Spektrochemische Analysen mit Roentgenfluoreszenz by Klaus Keil.

The book gives the subject in three parts: principles and qualitative analysis (absorption and scattering of x-rays, characteristic emission spectra, photoelectrons, fluorescent yields, and Auger electrons, qualitative analysis, fluorescent intensity of a pure element, fluorescent intensity of an element in two- and multicomponent mixtures, interelemental or secondary excitation, grain-size and surface roughness effects, intensity formula for a divergent primary beam, apparatus, measurement techniques): quantitative analysis (calibration curves and regression coefficients, determination of low concentrations, determination of thin film thicknesses, determination of high concentrations with calibration curves, determination of concentration, formulated as a linear system of equations, analysis of multicomponent mixtures and solutions for the linear system of equations): examples of applications, and abstracts of selected papers from the literature (analysis of mixtures which are difficult to separate chemically, steel and iron industry, base metals and ores, light-metal industry, determination of thicknesses of thin films, cement industry and silicate and rock chemistry, petroleum and coal industry, chemical industry, medicine and biology, analysis of small amounts of substance and of small areas). (UK)

50257 DETERMINATION OF LANTHANUM IN COBALT-BASE ALLOYS BY X-RAY FLUORESCENCE SPECTROMETRY. Haftka, F. J. (Union Carbide European Research Associates, Brussels). Anal. Chem.; 44: No. 11, 1900-2(Sep 1972).

A method is presented for determining lanthanum in the concentration range 0.01 to 0.2% in cobalt-base alloys containing about 20% chromium, 20% nickel, and 10% tungsten by x-ray fluorescence spectrometry. (D.H.M.)

50258 DETERMINATION OF SCANDIUM BY PRECIPITATION WITH BENZILIC ACID. Mullin, Michael H.; Hahn, Richard B. (Wayne State Univ., Detroit). Anal. Chem.; 44: No. 11, 1878-9(Sep 1972).

A gravimetric method for determining scandium is presented using benzilic acid as precipitant. Since zirconium is a serious interference in most analytical methods of determining scandium, the possibility of separating scandium and zirconium using benzilic acid was investigated. A ^{46}Sc tracer study showed the separation of Sc from Zr to be quantitative when Zr was precipitated with benzilic acid from 4 N hydrochloric acid and the pH of the filtrate adjusted to 2.5 and Sc determined by the gravimetric method described. (D.H.M.)

50259 DETERMINATION OF THE LUTETIUM CONTENT ACCORDING TO THE ACTIVITY OF THE ISOTOPE ^{176}Lu. Kodiri, S. S.; Starchik, L. P. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 162-4(1972).

Translated from Radiokhimiya; 14: No. 1, 155-7(1972).

By measuring the natural gamma activity of ^{176}Lu with a scintillation pickup, in conjunction with a pulsed amplitude analyzer, the lutetium content in a mixture of rare earth elements and yttrium can be determined with a sensitivity sufficient for many purposes. (M.C.G.)

50260 ISOTOPE GAS ANALYSIS OF TRITIUM-LABELLED ORGANIC COMPOUNDS BASED ON PYROLYTICAL DECOMPOSITION. Gacs, I.; Mlinko, S.; Payer, K. (Central Research Inst. for Chemistry, Budapest). Mikrochim. Acta; No. 3, 326-33 (1972).

A procedure was developed for the activity measurement of tritium-labeled organic compounds in the gas phase. The organic compounds are pyrolyzed in hydrogen carrier gas at 1150° and the decomposition products are swept through a carbon packing in accordance with the principle of the oxygen determination developed by Unterzaucher and Bürger. The radioactive gas mixture obtained from the sample is swept by the hydrogen carrier gas flowing continuously through the reactor into a proportional counter tube, after the addition of propane—butane counter gas. By closure of the counter tube at a suitable moment, the radioactive gas is quantitatively trapped in the counter tube. The activity is measured in the limited proportional region. No memory effect occurs. The preparation of the sample requires 12 minutes; the relative standard deviation of analysis is <0.5%. (auth)

50261 SELECTIVE DETECTION OF RADIOIODINE IN GASEOUS EFFLUENTS FROM NUCLEAR POWER PLANTS. Hladky, Eduard; Moravek, Jozef; Pietrik, Ivan (Power Research Inst., Jaslovske Bohunice, Czech.). Jad. Energ.; 18: No. 8, 266-72 (Aug 1972). (In Czech).

The quantity and composition of radioactive gaseous effluents from an atomic power reactor are noted. Methods of detecting radioactive iodine are summarized, and a new type of detector is proposed, based on the retention of the iodine in a special filter located in the well of a large scintillator. The activity of the accumulated radioiodine is measured in the interval 300 to 500 keV. Satisfactory sensitivity was achieved, and other gaseous fission products practically do not interfere. (tr-auth)

Separation Procedures

Refer also to abstracts 50401, 50402, 50432, 50433, 50442, 52033, 52372, 52392, and 52393.

50262 (LBL—614) SYNTHESIS OF SEPARATION SCHEMES. Thompson, Roger W.; King, C. Judson (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1972. Contract W-7405-eng-48. 179p. Dep. NTIS.

Thesis submitted by Roger W. Thompson.

The ability of the computer to synthesize complex separation schemes was investigated and demonstrated. Several new concepts were generated as a result of the evolving programming study. The hierarchical ordering of executive routines in a synthesis system allows great flexibility in adding or modifying detailed simulation routines for separator units. Products rather than components are being separated. A Product Separability Matrix was created to identify the candidate separations and to eliminate those that are infeasible as early as possible in the selection process. Incorporation of heuristics into the programming was done where no algorithmic procedure could be ascertained or where the use of heuristic procedures would save time without a major loss of generality. A number of heuristics were designed and evaluated. A new general heuristic, which should be of value to the design engineer, whether or not he is using the computer, is that the next separator to be incorporated into the separator sequence at any point is the one that is cheapest. This rule-of-thumb is useful when the candidate feasible separator sequences have been identified previously, as with the Product Separability Matrix. This heuristic rule was explored in some depth, and factors leading to exceptions from the rule were identified. A number of illustrative examples (separation of hydrocarbons, rare earths, etc.) are included. (auth)

50263 (SRO—525-4) ION EXCHANGE MEMBRANES. Progress Report, July 1971—June 1972. Baker, B. L. (South Carolina Univ., Columbia. Coll. of Engineering). Jul 1972. Contract AT-(38-1)-525. 18p. Dep. NTIS.

Investigation of the use of the Donnan potential applied to ion exchange membranes as a transfer process for removal and/or the concentration of ions was continued. The Donnan potential is developed by a charge build up on the surface of the membrane, which is opposite to the kind of ions the membrane will pass. Studies were made on the use of chelating and/or complexing agents in conjunction with the Donnan potential to separate ions of the same charge. (M.C.G.)

50264 ELECTROPHORETIC SEPARATION OF METAL IONS BY APPLYING COMPLEXING AGENTS IN NARROW BAND. Nakatani, Mitsuo; Sakanoue, Masanobu (Kanazawa Univ., Japan). Jap. Anal.; 21: No. 7, 942-4(Jul 1972). (In Japanese).

It was proposed that a sharp and effective electrophoretic separation of metal ions can be made by applying complex forming agents in a narrow band on the supporting medium ("Cellogel") moistened uniformly with the background electrolyte (0.1 M $NaClO_4$). As an example, the mixture of $^{90}Sr-^{90}Y$ in a radioactive equilibrium was tested by using 0.1 M EDTA (pH = 3 or 9) as a complexing agent. The yttrium ion migrating to the cathode reversed to the anode after encountering an EDTA band. The radioactive band of yttrium was detected more sharply when the complexing agent was applied. Furthermore, the mobility of Y—EDTA complex was found to be less than that of free EDTA. This method may be applied to separate several metal ions in groups by applying various complex-forming agents. (auth)

50265 GAS-SOLID CHROMATOGRAPHY OF THE CHLORO-COMPLEXES OF LANTHANIDE ELEMENTS WITH ALUMINIUM CHLORIDE. Zvarova, T. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 11: No. 2, 113-17(25 Aug 1972).

Clear resolution of peaks of adjacent elements all through the lanthanide series was achieved by chromatographing the chloro-complexes on a glass bead-packed column. (auth)

50266 SEPARATION OF MICROQUANTITIES OF POTASSIUM AND RUBIDIUM FROM MACROAMOUNTS OF CALCIUM AND STRONTIUM. Toerko, J.; Szirtes, L. (Isotope Inst., Budapest). Radiochem. Radioanal. Lett.; 11: No. 2, 147-151(25 Aug 1972).

An ion exchange process for the separation of potassium and rubidium from calcium and strontium was investigated. A Dowex-50 cation exchanger was used in the experiments. Both calcium and strontium were present as EDTA complexes so they were not sorbed on the resin. Based on the data obtained the method can be recommended for use in both microanalytical and radioanalytical practice. (auth)

50267 COMPLEX FORMATION BETWEEN RARE-EARTH ELEMENTS AND TETRACYCLINE. Nastasi, Maria J. C.; Lima, F. W. (Instituto de Energia Atomica, Sao Paulo, Brazil). Radiochem. Radioanal. Lett.; 11: No. 2, 69-76(25 Aug 1972).

Experiments based on the change of wavelength of maximum absorbance of pure tetracycline solutions, and of tetracycline plus lanthanide solutions, indicate the formation of the corresponding complexes. Extraction behavior of the complexes in benzyl alcohol is described. The percent extraction was determined for rare-earth elements and for scandium, as a function of the pH of the aqueous phase. The hydrogen ion dependence of the extraction of La, Nd, Sm, Dy, and Lu is presented as well as dependence of the extraction of La, Eu, and Lu on the extractant. (auth)

50268 INFLUENCE OF FLUORINE ON THE PRECIPITATION OF MOLYBDENUM FROM TUNGSTATE SOLUTIONS. Khar'kovskii, I. A. Tsvetn. Metal.; No. 2, 46-8(Feb 1972). (In Russian).

The presence of F^- ion reduced the extraction of Mo in the residue from the precipitation of the latter in the form of the sulfide. A linear dependence between Mo recovery and F^- concentration was observed, and a mechanism was proposed for this reaction based on the formation of an oxyfluoride complex. (tr-auth)

50269 EXTRACTION OF SOME TRIVALENT LANTHANIDES AND AMERICIUM(III) BY NEUTRAL ORGANO-PHOSPHOROUS EXTRACTANTS FROM THIOCYANATE SOLUTIONS. Khopkar, P. K.; Narayanankutty, P. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 34: No. 8, 2617-25(Aug 1972).

Extraction of La(III), Eu(III), Lu(III), and Am(III) from 1M NH_4SCN at pH $\sim$ 2.8 by tri-n-octyl-phosphine oxide (TOPO), tri-n-butyl phosphine oxide (TBPO), and tri-n-butyl phosphate (TBP) in xylene medium was studied. Extraction of thiocyanic acid from 1M NH_4SCN in the pH range of $\sim$2 to $\sim$3 by the three extractants in xylene was also investigated. It was found that thiocyanic acid was extracted as $HSCN \cdot R_3PO$ by the three extractants and equilibrium constants for this extraction were calculated. The metal ions were extracted as neutral, solvated, probably anhydrous species $M(SCN)_3 \cdot XR_3PO$, X in general having the values of 4 and 3 for the lighter and the heavier lanthanides respectively. The complexes $Nd(SCN)_3 \cdot 4TOPO$ and $Er(SCN)_3 \cdot 3TOPO$ were prepared and their absorption spectra were recorded. (auth)

50270 EXTRACTION AND EXTRACTION CHROMATOGRAPHY OF URANIUM(IV) WITH PHOSPHORIC ACID ESTERS AND ALKYLSUBSTITUTED AMMONIUM NITRATES FROM NITRIC ACID SOLUTIONS. Schmid, Erich R. (Univ., Vienna). Mikrochim. Acta; No. 4, 544-70(1972). (In German).

Extractive and extraction chromatographic behavior of uranium(IV) between nitric acid and organic extracting agents is described. Tri-n-butyl phosphate, bis(2-ethylhexyl) phosphate, and the nitrate salts of the amines Primene JM-T (a primary amine), Amberlite LA-1 (a secondary amine), trilauryl amine (a tertiary amine) and the quarternary ammonium salt Hyamine-1622 in the nitrate form were used as extracting agents. The uranium(IV) distribution ratios determined by batch experiments in separatory funnels agree with those determined by extraction chromatography in glass columns. The advantages and disadvantages of both methods are compared. The influence of the structure of the extracting agents, the influence of the diluents on the extraction of uranium(IV) and the composition of uranium(IV) complexes in organic phases were investigated: in phases containing the alkyl-substituted ammonium salts the uranium(IV) is always and only present as uranium(IV) hexanitrato complex. In the phases of phosphoric acid esters various different species of uranium(IV) exist. The ratio of the different uranium(IV) complexes among one another is dependent on the concentration of the nitric acid. These results were obtained mainly by analyzing the characteristic absorption spectra between 400 and 700 nm and from the dependence of the uranium(IV) distribution ratio on the concentration of the extracting agent in the organic phase at low uranium(IV) concentrations. (auth)

50271 DETERMINATION OF EXTRACTION CONSTANT BY STOICHIOMETRIC DILUTION. Budesinsky, Bret W. (Univ. of Arizona, Tucson). Z. Phys. Chem. (Frankfurt); 79: No. 1-2, 19-27(Jul 1972).

Two variants of stoichiometric dilution can be used for investigation of extraction equilibria. The first works within usual conditions, the second employs an excess of reagent to obtain the quantitative extraction. Both were used for the determination of extraction constants of cobalt(II), copper(II), nickel(II) and uranyl complexes of 8-hydroxyquinoline, copper(II) complexes of 8-hydroxy-2-methylquinoline and 8-hydroxy-2-styrylquinoline, and scandium and uranyl complexes of dibenzoylmethane. Chloroform was used as organic phase. (auth)

50272 CHARACTER OF SORPTION OF FREE IODINE BY NITROGENOUS AND FERROCYANIDE TYPE SORBENTS. Kazakov, E. V.; Volokhovskaya, V. N.; Gubanova, L. S.; Prulenko, L. Ya. Vestn. Leningrad. Univ., No. 4, Fiz., Khim.; No. 1, 120-5(Feb 1972). (In Russian).

Isotherms of free iodine sorption are obtained on ion exchange resins AB-17 from solutions of different concentrations and temperatures. Iodine sorption characteristics are studied on anion exchange resins containing nitrogen by various physical-chemical methods (x-ray analysis, IKS method.) The iodine saturation value of sorbents containing nitrogen and ferrocyanide organic ions was found to approximate the industrial recovery from natural and underground oil-well brines. (auth)

50273 EXTRACTION OF EUROPIUM FROM AQUEOUS SOLUTIONS BY VARIOUS β-DIKETONES. Korenman, I. M.; Domrachev, G. A.; Gryaznova, M. I.; Zakharova, R. P. Zh. Neorg. Khim.; 17: No. 5, 1429-32(May 1972). (In Russian).

Complex formation in the system $Eu^{3+}-\beta$-diketone was investigated in the presence of quaternary ammonium bases by the method of extraction. During extraction from acid solutions there is formed the complex EuA_3, where A = the anion of the chelate-forming reagent. During extraction from alkaline solutions the complex formed is $[EuA_4]^-K^+$, where K = the protonated base. The distribution of Eu as a β-diketonate between various organic solvents and water was studied as a function of the pH of the aqueous phase. Extractants investigated included benzoyltrifluoroacetone. (tr-auth)

50274 SEPARATION OF URANIUM(IV) AND (VI) BY ELECTROPHORESIS. Luginin, V. A.; Tserkovnitskaya, I. A. Vestn. Leningrad. Univ., No. 4, Fiz., Khim.; No. 1, 138-40(Feb 1972). (In Russian).

The electrophoretic behavior of uranium(IV) and (VI) ions in complexon solutions was studied. A scheme for the separation of uranium(IV) and (VI) by paper electrophoresis in the solution of the complexon III is suggested. (auth)

50275 STUDY OF EXCHANGE PROCESSES ON ION-EXCHANGE RESINS WITH A RADIOACTIVE TRACING METHOD. II. EXCHANGE OF ALKALI AND ALKALINE EARTH METAL IONS ON A WEAKLY ACID ION-EXCHANGE RESIN. Madi, Istvan; Varro, Tibor Magy. Kem. Foly.; 78: No. 5, 233-9 (May 1972). (In Hungarian).

A study was made of the kinetics of exchange between radioactive alkali metal ($^{137}Cs^+$) and alkaline earth metal ($^{90}Sr^{2+}$, $^{45}Ca^{2+}$) ions on the weakly acid ion-exchange resin Amberlite IRC-50, and the change with concentration of the equilibrium distribution coefficient, characteristic of the final result of the exchange process, was measured. The values of the characteristic rate constants of the exchange process and, on the basis of the change of the rate constants with temperature, the exchange activation energies were determined. From isotherm measurements the number of active functional groups was derived as a function of the temperature and of the nitric acid concentration of the solution. The diffusion of the $^{137}Cs^+$ ions within the resin phase was studied by an autoradiographic method, and the value of the diffusion constant was determined from the corresponding autoradiograms. (auth)

50276 SORPTION OF MOLYBDENUM FROM NITRIC ACID SOLUTIONS IN THE PRESENCE OF FORMIC AND ACETIC ACIDS. Sagortschev, B. N.; Todorova, N. G.; Baluhev, B. St. (School for Analytical Chemistry, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 1, 87-90(1972). (In German).

The comparative sorption of Mo from HNO_3 solutions by cation and anion exchange resins in the presence of formic and acetic acids was studied by shaking the mixture until the establishment of equilibrium. The three HNO_3 concentrations selected for the tests were 0.1N, 0.001N, and 0.00001N, and the concentration of the organic acids varied from 0 to 70%. Mo was determined by the thiosulfate method. In the case of the cation exchange resin, Mo sorption is not connected with any complexing ability of the organic acids. In the case of the anion exchange resin the presence of either acetic of formic acid increased the percent of Mo sorbed on the resin. (K.S.W.)

50277 COPRECIPITATION OF TRIVALENT THALLIUM WITH HYDROXIDES OF CERTAIN METALS. Plotnikov, V. I.; Gibova, E. G. Vestn. Akad. Nauk Kaz. SSR; No. 1, 64-7(Jan 1972). (In Russian).

The effect of a number of difficultly soluble metal hydroxides on the entrapment of thallium(III) was studied. The distribution of Tl between solutions and coprecipitates was determined using the radioisotope ^{204}Tl. The pH was adjusted to the desired values between 3 and 11 as a controlled variable. Different sets of experiments contained NH_4NO_3 or KNO_3, and employed NH_4OH or KOH as the precipitating agent. The collectors (metal hydroxides) tested included Y, Th, Zr, Fe, and Ti, and all of these proved to be efficient carriers of Tl under the proper conditions of pH, etc. (K.S.W.)

50278 SEPARATION OF THORIUM FROM LANTHANUM AND OTHER ELEMENTS BY CATION EXCHANGE CHROMATOGRAPHY AT ELEVATED TEMPERATURES. Strelow, F. W. E.; Gricius, A. J. (National Chemical Research Lab., Pretoria). Anal. Chem.; 44: No. 11, 1898-1900(Sep 1972).

A study of the effects of temperature on cation exchange distribution coefficients of Th, La, and Zr resulted in a method for separating lanthanum from thorium more efficiently on large and especially on small columns. It was found that the separation factor for thorium—lanthanum pair increases from 4.12 at 20°C to 6.17 at 60°C in 4 M HCl. It was also found that Gd, Y, Yt, Ti(IV), Fe(III), Al, Ca, and Mg are separated quantitatively together with lanthanum from thorium. (D.H.M.)

50279 EXTRACTION OF ELEMENTS BY TRIALKYLBENZYLAMMONIUM NITRATE FROM NITRIC ACID SOLUTIONS AND EXTRACTION CHROMATOGRAPHIC DISTRIBUTION OF Pt(IV), Re(VII), Mo(VI), AND W(VI). Artyukhin, P. I.; Startseva, E. A.; Mityakin, Yu. L.; (and others). Sov. Radiochem. (Engl. Transl.); 14: No. 1, 154-6(1972).

Translated from Radiokhimiya; 14: No. 1, 150-51(1972).

The extraction of 30 elements by trialkylbenzylammonium nitrate from nitric acid solutions was investigated. A method of extraction chromatographic separation Re(VII), W(VI), Mo(VI), and Pt(IV) is proposed. (auth)

50280 SEPARATION OF URANIUM AND PLUTONIUM BY AN ELECTROCHEMICAL METHOD. Samartseva, A. G.; Zhuravleva, Z. A. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 90-4(1972).

Translated from Radiokhimiya; 14: No. 1, 94-9(1972).

The electrochemical isolation of plutonium and uranium from such organic acids as formic, citric, and ascorbic acids was studied as a function of the hydrogen ion concentration and of the current density. The kinetics of electrochemical processes and optimum conditions for isolation of uranium and plutonium from solutions of formic acid were investigated. At pH = 2.9 and a current density of 100 mA/cm^2, in 25 to 30 min of electrolysis, plutonium is ~98% deposited on a platinum cathode, while in the case of secondary reprecipitation of plutonium and uranium, the yield of each of the components is >99.5%. (auth)

50281 STUDY OF ANION EXCHANGE OF Ce, Eu, Tu, AND Am IN AQUEOUS ALCOHOL SOLUTIONS OF AMMONIUM THIOCYANATE. Moskvin, L. N.; Novikov, V. T. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 102-5(1972).

Translated from Radiokhimiya; 14: No. 1, 106-10(1972).

The distribution of americium and the rare earth elements between an aqueous alcohol solution of ammonium thiocyanate and the anion exchange resin was studied as a function of the nature of the alcohol, its percent content, the concentration of ammonium thiocyanate, and the acidity of the solution. A hypothesis was advanced, explaining the influence of alcohol on the strength of anionic thiocyanate and nitrate complexes of the rare earth and transplutonium elements in aqueous alcohol solutions. The possibility of group separation of the rare and transplutonium elements in aqueous alcohol solutions with a low content of ammonium thiocyanate (0.05—0.8 M) was demonstrated. (auth)

50282 EXTRACTION WITH TRIBUTYYL PHOSPHATE FROM HYDROCHLORIC ACID SOLUTIONS. III. EXTRACTION OF COBALT. Levin, V. I.; Kozlova, M. D.; Sevast'yanova, A. S. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 44-50(1972).

Translated from Radiokhimiya; 14: No. 1, 48-54(1972).

The extraction of microquantities of cobalt (^{57}Co) from solutions of HCl + NaCl by tributyl phosphate was studied. It was shown that at a HCl activity in the aqueous phase less than 10, the extraction of cobalt occurs primarily in the form of $CoCl_2 \cdot 3TBP_{aq}$. The extraction constant of this complex is equal to $K_{e,1} = (9.07 \pm 0.09) \cdot 10^{-6}$. At higher HCl activities the extraction of $HCoCl_3 \cdot 3TBP_{aq}$, with extraction constant $K_{e,2} = (5.4 \pm 0.7) \cdot 10^{-8}$, predominates. (auth)

50283 HIGHER SOLVATES OF NITRIC ACID WITH TRIBUTYL PHOSPHATE. Rozen, A. M.; Nikolotova, Z. I.; Markov, V. S.; Teterin, E. G. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 59-67 (1972).

Translated from Radiokhimiya; 14: No. 1, 62-72(1972).

On the basis of data on the distribution of nitric acid at low concentrations and on the distribution of water, it was shown that together with the known anhydrous solvate in the extraction of nitric acid by tributyl phosphate, hydrosolvates $HNO_3 \cdot H_2O \cdot 2TBP$ and $HNO_3 \cdot h_3H_2O \cdot 3TBP$ ($h_3 = 1$ and, possibly, 4) are formed. The formation of hydrosolvates was confirmed by measurements of the ir spectra. The constants of formation of the hydrosolvates were found. The isotherm of extraction of the acid is described in a broad range of concentrations using them. Calculation shows that the concentration of hydrosolvates passes through a maximum at $X_H = 2.0$ to 3.0 M, while at $X_H = 7$ M the hydrosolvates are almost entirely displaced by the monosolvate. Because of the formation of higher solvates, the concentration of free TBP is substantially lower than that determined on the assumption of the formation only of the monosolvate. This should be taken into account in the quantitative treatment of the data on extraction from nitric acid media. (auth)

50284 RELATIONSHIP OF THE STABILITY OF INTERNAL COMPLEX COMPOUNDS TO THE DISSOCIATION CONSTANTS OF THE REAGENTS. Petrukhin, O. M. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 34-8(1972).

Translated from Radiokhimiya; 14: No. 1, 37-42(1972).

In connection with the problem of a priori estimation of the extraction constants of internal complex compounds, the dependence of the stability constant of internal complex compounds (β_n) on the dissociation constant of the reagent (K_{HA}) is discussed. It is shown that the change in the slope of a graph of $1/n \log \beta_n$ versus pK_{HA} can be explained by an increase in the fraction of the π-bond in the total energy of formation of the internal complex compound, which in turn can be compared with the nature of the donor atoms of the reagents and the position of the metal in the Periodic Table of elements. (auth)

50285 EXTRACTION OF URANIUM(IV) BY TRIBUTYL PHOSPHATE FROM MIXTURES OF PERCHLORIC AND NITRIC ACIDS. Vasil'ev, V. Ya.; Andreichuk, N. N.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 148-9(1972).

Translated from Radiokhimiya; 14: No. 1, 145-6(1972).

In extraction from mixtures with the composition xM HNO_3 + (Z—X)M $HClO_4$, the distribution coefficients of U(IV) were substantially higher than in extraction from nitric acid. It was found that both the value of the distribution coefficient and the number of forms of U(IV) existing in the organic phase depended on the concentration of perchloric acid. (M.C.G.)

50286 EXTRACTION OF URANIUM(VI) AND TRICHLOROACETIC ACID BY NORMAL PRIMARY ALCOHOLS. Bykhovtsov, V. L. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 174-5(1972).

Translated from Radiokhimiya; 14: No. 1, 165-6(1972).

The effectiveness of the extraction of uranium(VI) by normal primary alcohols increased from nitric acid solution to trichloroacetic acid solution. The U(VI) distribution coefficient decreased with increasing number of carbon atoms in the series of alcohols investigated. (M.C.G)

50287 RAYS OF EXTRACTION. PART 1. CURVILINEAR EXTRACTION RAYS. Nikolaev, A. V.; Kolesnikov, A. A.; Antonyants, I. A.; Petrov, V. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 2, 45-54(Jan 1972). (In Russian).

Phase diagrams were used with considerable success in the extraction of three-component systems. Four types of extraction were compared: integral, single-pass, differential, and countercurrent. All four types yield curved lines when a four-component system is plotted in only two dimensions by the technique presented; this is particularly true of the systems H_2O—TBP—acid—lanthanide or actinide. The principle of curvilinear extraction was demonstrated with the two systems: $La(NO_3)_3$—HNO_3—H_2O—TBP and $Pr(NO_3)_3$—HNO_3—H_2O—TBP. (K.S.W.)

50288 EXTRACTION AND SEPARATION OF THORIUM(IV) AND PROTACTINIUM(V) BY 2-CARBETHOXY-5-HYDROXY-1-(4-TOLYL)-4-PYRIDONE. Herak, M. J.; Janko, M. (Univ., Zagreb). J. Inorg. Nucl. Chem.; 34: No. 8, 2627-32(Aug 1972).

Extraction of thorium(IV) and protactinium(V) from hydrochloric acid solutions by 2-carbethoxy-5-hydroxy-1-(4-tolyl)-4-pyridone (HA) was investigated. The separation of protactinium from thorium is described. The mechanism of thorium extraction was studied. Regardless of the initial thorium concentration in the aqueous phase thorium passed into the organic phase only as $ThClA_3 \cdot HA$. The composition of the extractable thorium complex was determined graphically from the dependence of the distribution ratios on the concentration of HA in the organic phase and on the hydrogen ion concentration in the aqueous phase, and was further confirmed by elemental analysis and by the ir spectra. (auth)

50289 COLUMN CHROMATOGRAPHIC METHOD FOR SEPARATING MOLYBDENUM AS MATRIX ELEMENT IN THE DETERMINATION OF TRACES OF ALKALI AND ALKALINE EARTH METALS IN MOLYBDENUM AND MOLYBDENUM COMPOUNDS. Karajannis, S.; Ortner, H. M.; Spitzy, H. (Technische Hochschule, Graz). Talanta; 19: No. 8, 903-14(Aug 1972). (In German).

A new column chromatographic method for the separation of molybdenum as matrix element from traces of alkali and alkaline earth metals is described. The molybdenum(VI) sorption is achieved on Sephadex G-10 columns at pH 2.5 in ammonium chloride solutions, by the formation of an Mo$-$NH$_3$$-$glucose complex. Alkali and alkaline earth metal traces remain quantitatively in the effluent and are determined by flame-emission and atomic-absorption spectrophotometry, respectively. Separation time is slightly less than 2 h. With some automation the procedure is well suited for routine trace analysis of sodium, potassium, calcium, and magnesium in metallic molybdenum, MoO_3, MoO_2, MoS_2, etc. The coefficient of variation is ±10% up to 60 ppM, and ±5% at above 60 ppM. (auth)

50290 FLOCCULANT FILTER ION-EXCHANGE SYSTEM FOR THE CONCENTRATION OF ^{137}Cs IN WATER. Stewart, M. L.; Pendleton, R. C.; Lords, J. L. (Argonne National Lab., Ill.). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 345-7(Jul 1972).

A flocculant, filter, ion-exchange method of extracting ^{137}Cs from water is described. The technique is shown to be reliable and efficient in both laboratory and field calibration tests. The system recovered greater than 95% of the ^{137}Cs from both distilled water and river water to which ^{137}CsCl had been added. Recovery of ^{137}Cs from unspiked river water appeared to be equally efficient. (UK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 50209 and 51038.

Chemical and Physico-chemical Properties

Refer also to abstracts 50284, 50377, 50378, 50398—50401, 50403, 50413, 50439, 50728, 51040, and 52385.

50291 (ORNL—4801) REACTOR CHEMISTRY DIVISION. Annual Progress Report for the Period Ending May 31, 1972. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 151p. Dep. NTIS.

Progress is reported in six sections and a separate abstract was prepared for each section. (D.H.M.)

For abstracts of individual sections see: 50292, 50330, 50439, 51113, 51165, and 52385.

50292 (ORNL—4801, pp 1-23) MOLTEN SALT CHEMISTRY. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.

ALKALI METAL FLUORIDES—alkali metal fluorides—alkaline earth fluorides, interaction parameters of mixtures of, p. 4
—alkali metal fluorides—BeF^2, electrical conductivity and glass transition temperatures in melts of, p. 6
BERYLLIUM FLUORIDES—alkali metal fluorides—BeF_2, electrochemical mass transport in molten mixtures of, p. 5-6
BORON FLUORIDES—solubility of gaseous, in fluoride melts, p. 10
FUSED SALTS—chemistry of, research progress on
LITHIUM FLUORIDES—BeF_2—LiF, thermodynamics of mixtures of, from EMF measurements with beryllium and lithium—bismuth electrodes, p. 3
—BeF_2—CeF_3—LiF, phase studies, p. 9
MOLYBDENUM FLUORIDES—thermal decomposition of MoF_3, p. 21
NIOBIUM—fluorination with molybdenum hexafluoride, p. 22
—chemistry in molten fluorides, p. 18-9
NIOBIUM OXIDES—chemistry in molten lithium beryllium fluoride, p. 18-9
—reactions with fluorine at 375 to 550°C, study of vapor products from, p. 21
PROTACTINIUM—precipitation as oxide in MSBR fuel salt, p. 15
PROTACTINIUM OXIDES—PaO_2—ThO_2, exchange with molten salt reactor fluorides, p. 16-7
THORIUM OXIDES ThO_2—PaO_2—ThO_2—UO_2, activity coefficients of solid solutions of, p. 17-8
URANIUM FLUORIDES UF_3—disproportionation in molten beryllium fluoride—lithium fluoride in graphite containers, p.8
URANIUM FLUORIDES UF_4—equilibration of dilute molten fluoride solutions of, with uranium carbides, p. 7 (D.H.M)

50293 (UCRL—51238) REACTIONS OF METHANE AND OF CARBON MONOXIDE WITH TRITIATED WATER: A LITERATURE REVIEW. Weed, H. C. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Jun 1972. Contract W-7405-eng-48. 16p. Dep. NTIS.

This review is organized as a reference for those concerned with Plowshare experiments in hydrocarbon-bearing rocks, such as gas shale. Nuclear explosives produce natural gas in gas shale, and this gas contains tritium, which may be hazardous unless removed or diluted. Methods of removing tritium involve reactions between methane or carbon monoxide and H_2O, D_2O, or HTO. These compounds are important for tritium removal since they fix the tritium distribution between gas and condensed phases. While catalysis and radiolysis reactions of hydrocarbons are the main concern of this review, also considered are radioinduced catalytic activity in oxide insulators. The original sources for both subjects are Nuclear Science Abstracts and Chemical Abstracts. The search is most intensive from 1956 to 1972 and somewhat less so from about 1936 to 1956. No attempt is made here to cover the patent literature exhaustively, but rather to indicate the composition range of solid phase catalysts. (59 references) (auth)

50294 SELF-DIFFUSION OF $^{131}I^-$ AND $^{110}Ag^+$ IN MICROCONCENTRATIONS: THEIR MUTUAL INTERACTION AT HIGH DILUTION. Kepak, F.; Kriva, J. (Inst. of Nuclear Research, Rez, Czech.). J. Inorg. Nucl. Chem.; 34: No. 8, 2543-9(Aug 1972).

The self-diffusion of 10^{-8}M and 10^{-6}M I^- or Ag^+ ions and the effect of Ag^+ ions in concentrations of 10^{-9} to 10^{-5}M on the self-diffusion of 10^{-8}M and 10^{-6}M I^- in aqueous solution was studied. The presence of silver ions influenced the self-diffusion of iodide ions and from its course the gradual formation of trace amounts of AgI sol was inferred. (auth)

50295 DISSOCIATION OF SOME NITROAROMATIC ACIDS IN AQUEOUS SOLUTIONS. Kopecni, M. M.; Maksimovic, Z. B.; Secerov, M. M.; Beran, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade. Nuclear Research Inst., Rez, Czech.). Bull. Boris Kidric Inst. Nucl. Sci., Chem.; 22: No. 2, 9-15 (Sep 1971).

First and second thermodynamic dissociation constants of 3,5-dinitrosalicylic acid ($K_1 = 8.32 \times 10^{-4}$, $K_2 = 5.13 \times 10^{-4}$), 5-nitrosalicylic acid ($K_1 = 4.90 \times 10^{-4}$, $K_2 = 4.68 \times 10^{-11}$), and second dissociation constant of 4-nitro-1-phenol-2-sulfonic acid, indexed as 2-hydroxy-5-nitrobenzenesulfonic acid, ($K_2 = 2.82 \times 10^{-7}$, while $K_1 > 1$) were determined by uv spectrophotometry and potentiometry. (auth)

50296 STUDY OF PROCESSES OF DIFFUSION OF ^{22}Na, ^{42}K, ^{86}Rb, ^{134}Cs IN SOLID ALKALI SILICATE GLASSES. Malinin, V. R.; Evstrop'ev, K. K. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 169-71(1972).

Translated from Radiokhimiya; 14: No. 1, 160-2(1972).

The processes of self-diffusion studied using radioisotopes occur at a substantially higher rate than correspondingly lower activation energies and processes of heterodiffusion. The rate of processes of self-diffusion drops with increasing ionic radius of the diffusion cation in the series $Na^+ > K^+ > Rb^+ > Cs^+$. The processes of heterodiffusion are realized with a substantially greater activation energy than self-diffusion, regardless of the size of the diffusion cation and the alkali cation contained in the glass. An analysis of the diffusion parameters shows that there is a linear relationship between them, of the type of $\lg D_0 = a + b\Delta E_D$. (auth)

50297 KINETICS AND MECHANISM OF THE OXIDATION OF NITROSYLRUTHENIUM BY POTASSIUM PERMANGANATE. Koltunov, V. S.; Denotkina, R. G. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 95-101(1972).

Translated from Radiokhimiya; 14: No. 1, 99-106(1972).

The kinetics of the oxidation of nitrosylruthenium by permanganate in nitric acid medium was investigated. The rate of a first-order reaction with respect to both reagents decreased with increasing H^+ ion concentration in the interval from 0.1 to 1 M and did not depend on the acidity of the solution at $[H^+] > 1$ M. Nitrate ions inhibited the oxidation of $RuNO^{3+}$. The kinetic equation was found and the rate constants and activation energy of the reaction were calculated. The mechanism of the reaction, including interaction of $RuNO^{3+}$ and $RuNO(OH)_3$ with MnO_4^- ions as limiting steps is discussed. (auth)

Isotope Effects

Refer also to abstract 51546.

50298 INFRARED SPECTRA OF $RbHSO_4$ AND $RbDSO_4$ IN THE PARA- AND FERROELECTRIC PHASES. Mielke, Z.; Ratajczak, H. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 3, 255-63(1972).

Infrared spectra (4000 to 400 cm^{-1}) of $RbHSO_4$ and $RbDSO_4$ powder crystals were obtained at room and liquid N_2 temperatures, i.e., for the para- and ferroelectric phases. The splitting of all hydrogen bond vibrations into two components was observed in the ferroelectric phase. The infrared spectra obtained are discussed in relation to the crystallographic structure of crystals studied. (auth)

50299 ISOTOPE EFFECTS IN PROTON-TRANSFER REACTIONS. IV. THEORETICAL CALCULATIONS OF ISOTOPE EFFECTS IN THE RACEMIZATION OF 2-METHYL-3-PHENYLPROPIONITRILE. Bergman, Nils-ake; Saunders, William H. Jr.; Melander, Lars (Univ. of Goteborg. Chalmers Inst. of Tech., Goteborg). Acta Chem. Scand.; 26: No. 3, 1130-40(1972).

A computer program was used to calculate the kinetic isotope effect in the proton/deuteron abstraction from 2-methyl-3-phenylpropionitrile by methoxide ion in methanol as well as the equilibrium constant for the protium–deuterium exchange between the nitrile and methanol. A somewhat simplified model for the nitrile was used. Two models for the transition state was used. One of the models was used for reactant-like transition states, the other for product-like transition states. Some of the transition-state force constants were varied in order to take different degrees of transition-state symmetry into consideration. Several types of variation of the transition-state force constants were tested. The effect of these variations is discussed. In the equilibrium calculation the O–H stretching force constant is varied in order to simulate varying degree of hydrogen bonding. The results show that very weak kinetic isotope effects can be obtained for highly unsymmetric transition states. In the case of a very reactant-like transition state the isotopic rate ratio approaches the square root of the inverse ratio between the two isotopic reduced masses of the reactant molecules. For a highly product-like transition state the isotopic rate ratio approaches the square root of the inverse ratio between the two isotopic reduced masses of the product molecules multiplied by the ratio of the equilibrium constants of the corresponding isotopic reaction equilibria. For all models tested it is shown that the proton cannot be more than 1% transferred for a reactant-like transition state or must be more than 99% transferred for a product-like transition state if the value of the isotopic rate ratio is to deviate from the limiting value by less than 10%. The results are compared with the experimental value for the kinetic isotope effect in the racemization of 2-methyl-3-phenylpropionitrile in methanol and the value found experimentally for the isotope exchange equilibrium constant. (auth)

50300 SULFUR ISOTOPE EFFECTS. IV. SULFUR ISOTOPE EFFECTS IN ANION EXCHANGE SYSTEMS. Eriksen, Trygve E. (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 26: No. 3, 980-4(1972).

Measurements of the isotopic exchange coefficient for the sulfur isotopes $^{34}S-^{32}S$ at 25°C in the ion exchange reaction $HSO_{2aq}^{-} = HSO_{3R}^{-}$ were carried out by means of adsorption experiments, and the isotope effect for the gross heterogeneous chemical exchange equilibrium, $^{34}SO_{2g} + H^{32}SO_{3R}^{-} \rightleftharpoons {}^{32}SO_{2g} + H^{34}SO_{3R}^{-}$, measured by displacement experiments in a "fluidized anion-exchanger bed." (g, aq and R relate to gaseous, aqueous, and resinous phase, respectively.) (auth)

50301 MEASUREMENT OF THE RELATIVE RATE RATIOS OF THE FIRST AND SECOND STEPS OF THE HYDROBORATION REACTION AND THE RATES OF ALKYLBORANE REDISTRIBUTION REACTIONS. DISCUSSION OF THE OVERALL MECHANISM OF THE HYDROBORATION REACTION. Pasto, D. J.; Lepeska, B.; Balasubramaniyan, V. (Univ. of Notre Dame, Ind.). J. Amer. Chem. Soc.; 94: No. 17, 6090-6(23 Aug 1972).

The relative rates of the first and second steps of the hydroboration reaction of alkenes capable of proceeding to the di- and trialkylborane stage were measured. In all cases studied the rate constant for formation of the dialkylborane from monoalkylborane and alkene is larger than the rate constant for the formation of alkylborane from borane and alkene. The rate constants for the redistribution reactions $BH_3 + R_3B \rightleftharpoons R_2BH + RBH_2$, $2RBH_2 \rightleftharpoons R_2BH + BH_3$, and $2R_2BH \rightleftharpoons R_3B + RBH_2$ were determined at 40°C for the n-propylborane system ($R = n\text{-}C_3H_7$). All of the bimolecular rate constants for the forward and reverse redistribution reactions are considerably smaller than the hydroboration reaction rate constants. The formation of dialkylborane from monoalkylborane and alkene in systems in which alkylborane monomer-dimer equilibrium constants are not prohibitively large is proposed to occur via reaction between an alkylborane monomer-tetrahydrofuran complex and alkene. The greater reactivity of the monoalkylborane relative to borane is attributed to a weaker complexing interaction in the monoalkylborane–tetrahydrofuran complex than in the borane–tetrahydrofuran complex, thus resulting in a lowering of the activation energy for nucleophilic attack by an alkene on borane–tetrahydrofuran with partial displacement of the tetrahydrofuran. The differing sterochemical results obtained in the hydroboration of alkenes with monoisopinocampheylborane under various conditions are discussed in terms of the relative rates of addition vs. redistribution reactions. It is concluded that hydroboration with monoisopinocampheylborane produces alcohol of one configuration, whereas hydroboration with diisopinocampheylborane produces alcohol of opposite configuration. The results and conclusions reported in this article reinforce the conclusion that the hydroboration of an alkene with borane in tetrahydrofuran involves the direct reaction between a molecule of the borane–tetrahydrofuran complex and a molecule of the alkene. Values are given for hydrogen-tritium isotope effects for the hydroboration of alkenes with mono- and dialkylboranes. (auth)

50302 AROMATIC ARYLATION WITH ARYL RADICALS. IV. THE KINETIC HYDROGEN ISOTOPE EFFECT IN THE AROMATIC PHENYLATION WITH PHENYL RADICAL. Kamigata, Nobumasa; Minato, Hiroshi; Kobayashi, Michio (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Jap.; 45: No. 7, 2042-6(Jul 1972).

Anisole-4d, chlorobenzene-4d, chlorobenzene-d_5, nitrobenzene-d_5, m-dinitrobenzene-d_4, and 1,3,5-tri-t-butylbenzene-d_3 were phenylated with phenyl radical generated from PhN_2BF_4–$NaNO_2$, N-nitrosoacetanilide, or phenylazotriphenylmethane (PAT), and the isotope effect in these phenylations was determined. The values of k_H/k_D in the phenylations of chlorobenzene and 1,3,5-tri-t-butylbenzene are not much greater than unity, whereas that in the phenylation at the 2-position of m-dinitrobenzene with PAT was very large (~11). (auth)

50303 INFRARED INTENSITIES OF CRYSTALLINE NH_3 AND ND_3. Uyemura, Masakatsu; Maeda, Shiro (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 45: No. 7, 2225-6(Jul 1972).

The absolute infrared intensities of crystalline NH_3 and ND_3 films deposited at 77°K are reported. The intensity behavior in the course of annealing is described. (J.G.B.)

50304 ELECTRON SPIN RESONANCE EVIDENCE FOR THE PHOTOSENSITIZED DISSOCIATION OF HYDROGEN MOLECULES ON VANADIUM OXIDE. Katsu, Takashi; Sato, Mitsuo; Fujita, Yuzaburo (Tokyo Univ.). J. Phys. Chem.; 76: No. 18, 2637-9(31 Aug 1972).

Results are presented of ESR studies of the photodissociation of hydrogen molecules on surfaces of PVG(V_2O_5) (vanadium oxide dispersed on the surface of porous Vycor glass) with light $\lambda >$ 350 nm and H atom scavenging experiment with preadsorbed ethylene molecules that demonstrate the photosensitized decomposition of hydrogen molecules on the surface of the PVG(V_2O_5) at 77°K. Isotope effects in the β-proton hyperfine splitting of ethyl radicals were observed. (D.H.M.)

Isotope Exchange and Isotope Separation

Refer also to abstracts 50759, 50762, and 50765.

50305 (MLM–1928) DETERMINATION OF DI-n-BUTYLAMINE AND TRIETHYLAMINE BY GAS–LIQUID CHROMATOGRAPHY, NUCLEAR MAGNETIC RESONANCE AND INFRARED SPECTROSCOPY. Warner, D. K.; Attalla, A. (Mound Lab., Miamisburg, Ohio). 28 Aug 1972. Contract AT-33-1-GEN-53. 15p. Dep. NTIS.

Three independent instrumental methods for the determination of di-n-butylamine in triethylamine are described. The nuclear magnetic resonance, infrared, and gas-liquid chromatographic methods were developed for application to amine solutions having a di-n-butylamine concentration range of 10 to 50 wt%. As measured by the 95% confidence limits as a percentage of the mean instrumental measurement, the precisions of the magnetic resonance, infrared, and chromatographic techniques were 2.2%, 1.3%, and 0.7%, respectively. At the 95% confidence level, some statistically significant differences between the methods were found; however, the gas–liquid chromatographic method, because of its superior statistical reliability, is the preferred method. The determination of di-n-butylamine in triethylamine is used in connection with correlation of the efficiency of a method for enrichment of ^{13}C in CO_2. (auth)

50306 ISOTOPIC FRACTIONATION OF HYDROGEN IN THE H_2O–OH SYSTEM. Znamirovschi, V. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 1, 23-8(1972). (In Rumanian).

The general equation of the equilibrium curve for the deuterium content in the H_2O–OH system was established by taking into account complex exchange equilibrium. This equation may be utilized for basic (H_2O–OH^-) and alcoholic solutions (H_2O–ROH). When the equilibrium constants are not known, the equilibrium curve may be plotted with the help of the fractionation factor that may be determined by NMR methods. These measurements may also be utilized for determining the equilibrium constant values of the isotopic molecular reactions. (auth)

50307 SULFUR ISOTOPE EFFECTS. I. THE ISOTOPIC EXCHANGE COEFFICIENT FOR THE SULFUR ISOTOPES $^{34}S-^{32}S$ IN THE SYSTEM $SO_{2g}-HSO^-_{3aq}$ AT 25, 35, AND 45°C. Eriksen, Trygve E. (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 26: No. 2, 573-80(1972).

Measurements of the isotopic separation coefficient for the sulfur isotopes $^{34}S-^{32}S$ in the system $SO_{2g}-HSO^-_{3aq}$ were carried out at 25, 35, and 45°C by means of a method analogous to a Rayleigh distillation. The results obtained are compared with the coefficient obtained by theoretical calculations based on statistical theory. (auth)

50308 SULFUR ISOTOPE EFFECTS. II. THE ISOTOPIC EXCHANGE COEFFICIENTS FOR THE SULFUR ISOTOPES $^{34}S-^{32}S$ IN THE SYSTEM SO_{2g} AQUEOUS SOLUTIONS OF SO_2. Eriksen, Trygve E. (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 26: No. 2, 581-4(1972).

The isotopic exchange coefficient for the phase transfer reaction, $^{34}SO_{2g} + {}^{32}SO_{2aq} \rightleftharpoons {}^{32}SO_{2g} + {}^{34}SO_{2aq}$, was measured at 25, 35, and 45°C by means of Rayleigh distillation. From the results obtained previously for the system $SO_{2g}-HSO^-_{3aq}$ the exchange coefficient for the protolytic reaction, $^{34}SO_{2aq} + H^{32}SO^-_{3aq} \rightleftharpoons {}^{32}SO_{2aq} + H^{34}SO^-_{3aq}$, was calculated. (auth)

50309 SULFUR ISOTOPE EFFECTS. III. ENRICHMENT OF ^{34}S BY CHEMICAL EXCHANGE BETWEEN SO_{2g} AND AQUEOUS SOLUTIONS OF SO_2. Eriksen, Trygve E. (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 26: No. 3, 975-9(1972).

The isotope fractionation factors for the sulfur isotopes $^{34}S-^{32}S$ between sulfur dioxide and aqueous solutions of sulfur dioxide with different fractions of the species SO_{2aq}, HSO^-_{3aq} and $S_2O^{3-}_{5aq}$ were measured at 25, 35, and 45°C. (auth)

50310 STUDIES ON THE ISOTOPIC EXCHANGE BETWEEN A MONOLAYER DEPOSITED ON NOBLE METAL SURFACES AND AQUEOUS SOLUTIONS. I. Miller, Janos; Toth, Geza Magy. Kem. Foly.; 78: No. 5, 265-73(May 1972). (In Hungarian).

A ^{111}Ag monolayer was deposited onto a smooth platinum surface with the aid of the reaction $Pt(H) + Ag^+ \rightarrow Pt(Ag) + H^+$. Experimental proof was obtained that the Ag atoms of the monolayer do not participate in the surface diffusion and do not get into the bulk of the platinum. The energetic inhomogeneity of the platinum surface was characterized quantitatively by the statistical distribution function derived from the kinetic data of the heterogeneous isotope exchange between the Ag monolayer and nonradioactive aqueous $AgNO_3$ solution. The independence of the exchange rate from the diffusion rate in the aqueous phase is preliminarily shown. Linearity of the logarithm of the unchanged fraction versus the superficial Pt—Ag bond energy was established. In equilibrium studies, such distribution can be derived from Freundlich isotherms. (auth)

50311 ^2H AND ^3H IN STUDIES OF HETEROGENEOUS CATALYTIC-EXCHANGE REACTIONS. Frangopol, Maria (George Washington Univ., Washington, D. C.). Isotop. Radiat. Technol.; 9: No. 4, 447-55(1972).

Uses of ^2H and ^3H as tracers in studies of heterogeneous catalytic-exchange reactions of hydrocarbons are reviewed. Reactions of alkanes and of cycloalkanes with ^2H, explained primarily by a dissociative mechanism, are given as examples. Studies on molecules with an asymmetric carbon atom, as well as on highly symmetrical molecules (methane, ethane, cyclopentane, -hexane, -heptane, -octane, and neopentane), are considered. Interaction of unsaturated hydrocarbons with the isotopes of hydrogen is a complex phenomenon that leads to hydrogenation, hydrogen exchange, double-bond migration, and cis-trans isomerization. Isotope exchange between aromatic hydrocarbons and ^2H on transition-metal catalysts is explained in terms of a π-complex mechanism. The associative and dissociative π-complex substitution mechanisms are compared with the corresponding classical mechanisms. Alkylbenzenes are discussed separately. Tritium-labeling methods based on isotope-exchange reactions are similar to those involving ^2H; several specific reactions are mentioned. (auth)

50312 STUDY OF THE TRAPPING OF IMPURITIES BY HYDROXIDES. V. TWO INDEPENDENT EXAMPLES OF THE SEGREGATION OF COBALT. Belousova, M. Ya.; Melikhov, I. V. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 7-11(1972).

Translated from Radiokhimiya; 14: No. 1, 9-13(1972).

It was shown by the method of isotopic exchange that cobalt is irreversibly sorbed by a stable precipitate of $Mg(OH)_2$ from a 3N solution of NH_4OH. The rate of isotopic exchange of sorbed cobalt with the solution increased with increasing amount of the sorbent in the precipitate. In the case of sorption of cobalt from alkaline solutions there was a decrease in the extent of the regions of coherent scattering of x rays along the normal to the direction of the close-packed layers of the crystals. Experimental data on sorption of cobalt correspond to the concept that at low cobalt contents and in the presence of a substantial concentration of ammonia in solution, trapping of an impurity leads to the formation of chains of impurity molecules, extending along the ribs of the block. Increasing the content of cobalt and decreasing the ammonia concentration promote the formation of flat impurity inclusions, localized on the interblock boundaries or in regular interlayer spaces of the crystals. (auth)

50313 REMARKS ON THE CRYSTALLIZATION AND DEHYDRATION OF COPPER SULFATE PENTAHYDRATE. Heinzinger, K.; Maiwald, B. (Max-Planck-Institut fuer Chemie, Mainz). Bull. Chem. Soc. Jap.; 45: No. 7, 2237-39(Jul 1972).

Isotope effects were used in studying crystallization and dehydration processes in hydrated crystals. The available hydrogen and oxygen isotope fractionation factors between the different kinds of water in the crystal, and between water of crystallization and the saturated solution, which are relevant in respect to crystallization and dehydration processes, are listed. The reported oxygen isotope fractionation factors are preliminary. (J.G.B.)

50314 FRACTIONATION OF OXYGEN AND CARBON ISOTOPES DURING FLOTATION OF CALCITE. Sharma, T.; Biswas, A. K.; Pillai, N. V. (Indian Inst. of Tech., Kanpur). Bull. Chem. Soc. Jap.; 45: No. 7, 2239-41(Jul 1972).

Oxygen and carbon isotopic compositions of calcium carbonate (calcite) obtained from floatation concentrates and tailings were studied in order to determine whether isotopic fractionation occurs during the floatation of calcium carbonate. Calcite from floatation concentrates and tailings obtained in the presence of hydrochloric, benzoic, citric, and oxalic acids were used. Results indicate that isotopic fractionation does take place. (J.G.B.)

50315 MECHANISM OF HYDROGEN EXCHANGE REACTIONS ON 1:2 ELECTRON DONOR—ACCEPTOR COMPLEXES OF ANTHRACENE WITH SODIUM. Ichikawa, Masaru; Tanaka, Sadao; Naito, Shuichi; (and others) (Tokyo Univ.). Bull. Chem. Soc. Jap.; 45: No. 7, 1956-60(Jul 1972).

The mechanisms of the H_2-D_2 and D_2-HZ exchange reactions over 1 : 2 Electron Donor-Acceptor (EDA) complexes of anthracene with sodium, where HZ denotes the EDA complexes, were studied kinetically and spectroscopically in the temperature range 20 to 90°C. It was found that molecular hydrogen exchanges directly with the hydrogen of the complexes ($An^{2-}2Na^+$ or An^-Na^+) and also with the monohydroanion complex (AnH^-Na^+), which is formed by the dissociative adsorption of hydrogen. The H_2-D_2 exchange reaction proceeded via not only the σ-bonded hydrogen of the complexes, but also homolytically dissociated "mobile" hydrogen. (auth)

50316 STABILITY OF BF_3OH^- ION IN MOLTEN AND SOLID $NaBF_4$ AND $NaF-NaBF_4$ EUTECTICS. Bates, J. B.; Young, J. P.; Murray, M. M.; Kohn, H. W.; Boyd, G. E. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2721-7(Sep 1972).

Infrared measurements on solutions of $NaBF_3OH$ in crystalline and molten $NaBF_4$ were employed to determine the stability of the BF_3OH^- ion with respect to its unimolecular decomposition. Isotopic substitution experiments with D_2O, DF, and D_2 show that the species BF_3OD^- is formed in molten $NaBF_4$ either by reaction with BF_3OH^-, with BF_2O^-, or with $B_2F_6O^{2-}$ mediated by a transition metal oxide. These isotope reactions give encouragement to the view that tritium released during the operation of a molten salt breeder reactor might be trapped by reaction with BF_3OH^- or with oxyfluoroborates present as impurities in the molten sodium fluoroborate coolant salt. (auth)

Feed Materials Processing

Refer also to abstracts 50446 and 50577.

50317 (DOCKET-406622—4) SHIRLEY BASIN URANIUM MILL. Environmental Statements, Supplemental Information. (Utah International, Inc., San Francisco, Calif.). 23 Jun 1972. 104p. Dep. NTIS.

Information is presented in response to nine AEC questions on the environmental report and supplement. Topics covered include: location; mining operations; geology and hydrology; general area description of plant and animal life; radionuclide releases and radiation doses to plants, animals, and man; economics; and accidents. (M.C.G.)

50318 (NLCO—883) RE-EXTRACTION OF URANIUM FROM TRI-n-BUTYL PHOSPHATE—KEROSENE SOLVENT. Cavendish, J. H. (National Lead Co. of Ohio, Cincinnati). 30 Aug 1963. Contract AT(30-1)-1156. 30p. Dep. NTIS.

Declassified 21 Oct 1971.

The re-extraction of uranium from tri-n-butyl phosphate—kerosene solvent in pulsed plate columns was investigated. Tests were conducted on the effects of the following variables: pulse power (the product of pulse amplitude and frequency); type of plate used in column; operating temperature; and addition of ammonium hydroxide at an intermediate point in the column. All these variables were found to significantly affect the capacity and/or efficiency of the column. The optimum operating conditions for the re-extraction operation in the National Lead Company of Ohio's Refinery were developed and were verified in a plant demonstration test. (auth)

50319 PLANT FOR THE COUNTER CURRENT PROCESSING OF ORES. Mouret, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,087,585. 6 Dec 1971. Filed 25 May 1970. (In French).

A plant for the processing of uraniferous ores containing uranium, which can be made soluble by sulfuric reaction, is presented. The water requirements of this plant are smaller than those of previous plants. The plant possesses equipment in which the ore is attacked by a concentrated reagent, equipment for washing the ore after it has been attacked by a counter current of circulating aqueous solution in a vertical column, and a means of drying the exhausted ore accumulated at the foot of the column. The washing facility of the column consists of a vertical counter current column provided with a means of continuously transporting the attacked ore to the head of the column and recovering the exhausted ore from the foot of the column. The washing facility is provided with a means of injecting the washing water into the lower part of the column, and a means of sampling the liquor from the head of the column. (France)

Radiation Chemistry

Refer also to abstracts 50679, 50754, 50803, 50806, 50810, 50921, 51120, 51126, 51141, 51154, 51165, and 51181.

50320 (AEC-tr-7138, pp 19-26) CALCULATION OF THE PARAMETERS OF A RADIATION SULFOCHLORINATOR RS-2.5. Osipov, V. B.; Solodikhina, L. D.; Terent'ev, B. M.; Dzhagatspanyan, R. V. Translated from Radiats. Tekh.; No. 3, (1969).

The RS-2.5 radiation sulfochlorinator is the first USSR industrial radiation-chemical reactor for the sulfochlorination of synthine (synthetic mixture of hydrocarbons). The working volume was about 2 m^3, and the heterogeneous reaction system consisted of synthine, Cl, SO_2, and HCl. A linear irradiator, assembled from ^{60}Co sources (assumed to be point sources), was placed in the center of the reactor. The total volume occupied by the gases and the mass absorption coefficients were determined, along with the mean absorbed dose rates. The distribution of the mean absorbed dose rate was found to be a power function of the radius of the RS-2.5. It was concluded that the calculated values, although somewhat high, were in good agreement with experiment; discrepancies were attributed to approximations made in the calculations. (5 figures, 1 table). (R.W.R.)

50321 (AEC-tr-7138, pp 93-101) RS-2.5 RADIATION-CHEMICAL REACTOR FOR SULFOCHLORINATION OF SATURATED HYDROCARBONS. Osipov, V. B.; Simonov, V. M.; Bodrov, D. P.; Dzhagatspanyan, R. V.; Mamikonyan, S. V.; Golubkov, S. V.; Shtan, A. S.; Solodikhina, L. D. Translated from Radiats. Tekh.; No. 3, (1969).

It is shown that the power consumption for initiation of the sulfochlorination of saturated hydrocarbons using ^{60}Co γ radiation on an industrial scale is only about 10 to 21.5 Whr per ton of 30% sulfochloride, while in the case of photochemical initiation the power consumption is about 14 kWh per ton of the same product. The development of an industrial-scale reactor is discussed. (M.C.G.)

50322 (AEC-tr-7138, pp 223-8) ECONOMIC FEASIBILITY OF THE PRODUCTION OF SULFONATE BASED ON A RADIATION METHOD. Osipov, V. B.; Guteev, V. P.; Dzhagatspanyan, R. V.; Golubkov, S. V. Translated from Radiats. Tekh.; No. 3, (1969).

The RS-2.5 radiation sulfochlorinator is described. The effect of ionizing radiation on the technical-economic parameters of sulfonate production from synthine is shown schematically. Capital investments and operation costs are discussed. (M.C.G.)

50323 (BNWL-1651(Pt.2), pp 83-6) CHARACTERIZATION OF RADIATION-INDUCED FREE RADICAL REACTIONS IN AQUEOUS SYSTEMS. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The chemical structures and reactivities of free radicals formed in irradiated model systems are being studied in order to understand and alleviate the development of radiobiological damage. Electron spin resonance spectroscopy and optical absorption spectrophotometry were used to identify the radicals and determine the kinetics of their reactions with other biochemical substrates in aqueous solutions. The damage-propagating abilities of the radicals were assessed by studying their reactivities toward diagnostic reagents, while methods for chemical protection for free-radical damage were tested in various biochemical systems. (auth)

50324 (CONF-711121-2) VISCOSITY EFFECTS IN RADIATION-INDUCED GRAFT POLYMERIZATION. Silverman, Joseph; Block, Ira (Maryland Univ., College Park. Lab. for Radiation and Polymer Science). 1971. 23p. Dep. NTIS.

From tenth Japan conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The radioinduced grafting of styrene to polyethylene and of butadiene to poly(vinyl chloride) and to chlorinated polyethylene is examined under conditions of high matrix viscosity. The high-viscosity conditions were achieved by three methods: brief exposure of polymer to gaseous monomer prior to irradiation; steady exposure to dilute solutions of the monomer in methanol during irradiation; chemical modification to increase the elastic modulus and glass transition temperature of the polymer prior to its simultaneous exposure to monomer and radiation. With the chlorinated polymers, several viscosity-modifying effects were observed to occur spontaneously during the grafting reaction. These viscosity-related effects lead to principles of radioinduced graft copolymerization, which appear to be useful in industrial applications and in the ESR study of grafted propagating radicals. (auth)

50325 (CONF-720828-1) FREE RADICAL CONCENTRATION MEASUREMENTS. Randolph, M. L. (Oak Ridge National Lab., Tenn.). 1972. 10p. Dep. NTIS.

From Symposium on radiation effects in biological systems (free radicals); Moscow, USSR (Aug 1972).

Concentration measurements whose purpose requires absolute values for ESR signals of marginal amplitude are described. Absolute values may be determined by comparing ESR spectra of unknown and of standard samples. (M.C.G.)

50326 (COO-1116-20(Pt.1)) KINETICS OF DECAY OF EXCITED RARE GAS ATOMS IN THE PULSE RADIOLYSIS OF RARE GASES. Technical Progress Report, Part I, September 1, 1971-July 24, 1972. Firestone, Richard F. (Ohio State Univ. Research Foundation, Columbus). 24 Jul 1972. Contract AT-(11-1)-1116. 61p. Dep. NTIS.

Progress is reported in studies of the kinetics of decay of excited atoms and growth of excited molecules in the pulse radiolysis of argon. Electric fields induced by the high current beam (Febetron 706) cause the dose per unit pressure in argon to decrease with increasing pressure below 400 torr. Electron beam screens are used to determine the proportionality between optical absorbance and concentration. The decay of excited atoms is of mixed second and third order at 200 to 800 torr. (auth)

50327 (EUR-4810(Vol.1), pp 237-52) COMPARISON OF THE RADICAL-DOSE RELATIONSHIP IN CLEAR POLYMETHYL METHACRYLATE FOLLOWING GAMMA AND FAST NEUTRON IRRADIATION. Chadwick, K. H. (Association EURATOM-ITAL, Wageningen, Netherlands).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The radiation-induced unstable optical density (OD) in PMMA is correlated with the free-radical concentration. A mathematical expression is considered which describes the relationship between radical concentration and radiation dose and an approximation of the expression is shown to fit the unstable OD—dose relationship following gamma and fast-neutron irradiation of PMMA. The effect of the different LET radiation on the various parameters in the expression is considered both in the case of PMMA and glycine. The results for glycine, obtained from literature, are shown to fit the full expression for the radical—dose relationship following gamma and high LET radiation. A connection between radical concentration, LET, and the modifiable proportion of radiobiological damage is suggested. (auth)

50328 (IAEA-R-662-F) STUDY OF THE RADIOSENSITIVITY OF PRECURSORS OF FUNCTIONAL BIOLOGICAL COMPOUNDS. Final Report, September 1, 1968-September 30, 1971. Munoz, R. A. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 14p. INIS.

The radiosensitivity of pyrrole, pyrrolidine, and proline, the principal compounds of collagen, was studied. The degradation of pyrrole by gamma radiation increased with increased irradiation dose and was influenced by the medium and by the pH of the solution. Oxygenated solutions were more degraded than those saturated with nitrous oxide or argon. Eight products of radiolysis were detected from pyrrole solutions irradiated under nitrous oxide atmosphere. The molecule of pyrrolidine required higher doses to be degraded. Solutions saturated with oxygen and nitrous oxide yielded high G values of ammonia at doses the order of 2,000 Krads. At higher doses these values were not affected, confirming the high stability of the molecule, due to the absence of double bonds in its structure. The presence of copper ion in the irradiated system increased the ammonia yield in oxygenated solutions, while the yield was lowered in solutions saturated with nitrogen oxide and argon. Six radiolysis products of pyrrolidine were detected by thin layer chromatography as colored spots developed with ninhydrin. In the case of proline, thirteen products of radiolysis were detected when a solution of L-proline uniformly labeled with carbon-14 was irradiated with a dose 4,032 Krads after bubbling oxygen through the sample. The products were detected with ninhydrin spraying, and by autoradiography of the plate. Collagen was deaminated at doses of the order to 200 Krads. The deamination was not affected much by further increase of irradiation dose and variation of pH, although a decrease in the deamination was found in strongly alkaline solutions. (INIS)

50329 (NP-19352) PHOTO AND RADIATION CHEMICAL REACTIONS OF DIPHENYLMETHYLENETRIPHENYLPHOSPHORANES. Shakaa, Hani (Bochum Univ. (West Germany)). 1971. 104p. (In German). Dep. NTIS (U. S. Sales Only). Thesis.

It is shown that the radiochemically rather inert reaction diphenylmethylenetriphenylphosphorane could be excellently accelerated photochemically as well as radiochemically. By use of these methods, the formation of cyclopropane derivatives was studied on a series of olefines. The olefines used, the cyclopropane derivatives obtained, and the yields were tabulated. Use of diphenyldiazomethane instead of the previous reagent, produced the same substances with olefine reaction partners. Diphenylmethylene was formed as an intermediate product. In addition to light, $^{60}Co_\gamma$ radiation also triggered the reactions; however, the photochemical process was more efficient. (H.B.G.)

50330 (ORNL-4801, pp 109-38) SPECIAL RESEARCHES. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.

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50331 (SRO-640-5) RADIOLYSIS OF WATER IN A WIDE RANGE RADIOLYSIS SOURCE. Progress Report, September 1, 1972–August 31, 1972. Melton, Charles E. (Georgia Univ., Athens. Dept. of Chemistry). 1 May 1972. Contract AT(38-1)-640. 47p. Dep. NTIS.

Dissociative-electron-attachment cross sections for the production of OH^-, O^-, and H^- from water vapor were determined. These cross sections are discussed within the framework of resonance scattering theory. The relatively low cross sections for the production of OH^-, 1.2, 0.85, and 0.85×10^{-21} cm² molecule^{-1} for maxima of 6.4, 8.4, and 11.2 eV, suggest that the atoms in the H_2O^- complex are loosely bound together and behave as essentially independent entities. All of the negative ions from H_2O appear to be produced from three different electronic states of the molecule. Results from this study were used to draw a hypothetical potential energy diagram for H_2O. These results complete the analysis of the first stage of the radiolysis reaction involving anions. The tertiary stage of the reactions was also completed. In this stage it was observed that intermolecular reactions of O^- and OH^- with H_2O produce O^-H_2O and OH^-H_2O. The rate constant for the former is 2.1×10^{-27} cc^3 sec^{-1} and that for the latter is 1.8×10^{-27} cc^3 sec^{-1}. The bond dissociation energy of OH^-H_2O was calculated to be 1.1 eV. The inter nuclear distance for R(O—H) was calculated to be 1.21 Å. The formation of the complexes is discussed in terms of both the energy transfer and bound complex mechanism. (auth)

50332 ELECTRON SPIN RESONANCE STUDIES OF PRIMARY PROCESSES IN RADIATION-INDUCED REACTIONS. III. 1,3-BUTADIENE IN ORGANIC RIGID MATRICES. Shiga, Tetsuo; Lund, Anders; Kinell, Olof (Swedish Research Council's Lab., Studsvik). Acta Chem. Scand.; 26: No. 1, 383-92(1972).

The primary species formed from 1,3-butadiene following γ irradiation in organic rigid matrices were investigated. The cationic radical of butadiene was observed in polycrystalline carbon tetrachloride. A radical of the type $CH_2 \doteq CH \dot{-} \dot{C}H \dot{-} CH_2 \dot{-} R$(RI) was formed in butyl chloride at 77°K. The positive charge scavenger triethylamine inhibits the formation of RI. Initiation by the butadiene cation was indicated in the radioinduced polymerization, yielding the radical RI in butyl chloride. The butadiene anion was observed at 77°K in 2-methyltetrahydrofuran, but the formation of the radical RI was not observed at 77°K. In hydrocarbon glasses of 3-methylpentane and 3-methylhexane the formation of the radical RI was observed in the presence of either positive or negative charge scavengers. Both cationic and anionic initiation were indicated at 77°K. (auth)

50333 RADIOLYSIS OF AQUEOUS TOLUENE SOLUTIONS. Christensen, H. C.; Gustafsson, R. (Aktiebolaget Atomenergi, Nykoeping, Sweden). Acta Chem. Scand.; 26: No. 3, 937-46(1972).

Aqueous toluene solutions were irradiated with ^{60}Co γ rays. In unbuffered solutions the various cresol isomers were formed in a total yield of 0.45, 0.87, and 0.94 molecules/100 eV absorbed energy in argon-, N_2O-, and air-saturated solutions, respectively. The yields were reduced in acid (pH 3) solutions (G = 0.14, 0.14, and 0.52, respectively) but the reduction was compensated by the formation of 1,2-diphenylethane in yields of 0.49 and 1.60 in argon- and N_2O-saturated solutions, respectively. Benzyl radicals were formed through an acid catalyzed water elimination reaction from the initially formed hydroxymethylcyclohexadienyl radical. Phenyltolylmethanes, dimethylbiphenyls, and partly reduced dimers were also formed during the radiolysis. Hydrogen was formed in the same yield as the molecular yield, g(H_2). Xylene isomers and benzene were formed in trace quantities. The most remarkable effect of the addition of Fe(III) ions to deaerated acid toluene solutions was the formation of benzyl alcohol and benzaldehyde and an increase in the yield of 1,2-diphenylethane. (auth)

50334 ELECTRON DISAPPEARANCE IN PULSE IRRADIATED CH_3Cl, C_2H_5Cl, CH_3Br, AND C_2H_5Br. Bansal, Krishan M.; Fessenden, Richard W. (Carnegie-Mellon Univ., Pittsburgh). Chem. Phys. Lett.; 15: No. 1, 21-3(15 Jul 1972).

Thermal electron attachment rate constants were determined for CH_3Cl, C_2H_5Cl, CH_3Br, and C_2H_5Br using a microwave conductivity-pulse radiolysis technique. Particular care was taken in purification of the compounds. With CH_3Cl and C_2H_5Cl only upper limits of $<1.9 \times 10^{-15}$ and $<1.6 \times 10^{-15}$ cm^3 molecule^{-1} sec^{-1}, respectively, could be obtained. The values for CH_3Br and C_2H_5Br were 7.0×10^{-12} and 2.8×10^{-13} cm^3 molecule^{-1} sec^{-1}, respectively. No evidence was found in any of the four cases for three-body electron attachment in the presence of an excess of propane. (auth)

50335 IONIC PROCESS IN γ-IRRADIATED 3-METHYLPENTANE GLASS CONTAINING TRIPHENYLAMINE. Ichikawa, Tsuneki; Yoshida, Hiroshi; Hayashi, Koichiro (Hokkaido Univ., Sapporo). Nippon Kagaku Kaishi; No. 6, 1005-9(Jun 1972). (In Japanese).

Formation and decay process of ionic species in γ-irradiated 3-methylpentane glass containing a small amount of triphenylamine (TPA) were studied by ESR, optical absorption, and emission measurements at 77°K. Radical cations and radical anions of TPA and trapped electrons were produced in the glass as ionic species. In glass matrices, radical anions of TPA gave a singlet ESR spectrum having a line width of 6 gauss, whereas cations of TPA gave a triplet ESR spectrum having a hyperfine coupling constant of 14 gauss. Decay rate of trapped electrons at 77°K obtained from the ESR measurement was directly proportional to that of radical cations obtained from the luminescence measurement, and both rates were not affected by the concentration of TPA. From the results, it was concluded that trapped electrons migrated in the glass at 77°K, and recombined with radical cations of TPA to form excited TPA molecules. (auth)

50336 STUDY BY MEANS OF GAMMA-RESONANCE SPECTROSCOPY OF THE STRUCTURAL TRANSFORMATIONS AND RADIOCHEMICAL PROCESSES IN SOLID BUTANEDIOL DIMETHACRYLATE. Gusakovskaya, I. G.; Larkina, T. I.; Trukhtanov, V. A.; Shcherbinin, Yu. S.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. A; 14: No. 6, 1390-5(Jun 1972). (In Russian).

Data from calorimetry, radiothermoluminescence, and gamma-resonance spectroscopy correlated. For butanediol dimethacrylate (BM) + $FeCl_3$ transitions of different kinds (γ, β, crystallization, premelting) were accompanied by changes in the Moessbauer effect and β-transition and crystallization were also accompanied by a change in the shape of the spectrum. The appearance of asymmetry in quadrupole splitting in the β-transition region testified to greater mobility in conjunction with arising orientation, which are favorable conditions for solid-phase polymerization. The Moessbauer additive $FeCl_2$ inhibits the radiation post-polymerization of BM glass. This fact, as well as the appearance after irradiation of the Fe^{2+} lines in the spectrum, points to the electronic mechanism of post-polymerization. (auth)

50337 ISOMERIZATION OF $C_4H_9^+$ IONS ORIGINATING FROM IRRADIATED GASEOUS ETHYLENE. Gawlowski, J.; Niedzielski, J. (Univ., Warsaw). Radiochem. Radioanal. Lett.; 11: No. 2, 105-12(25 Aug 1972).

The formation of isomeric butenes from ethylene irradiated in the gas phase was investigated using ammonia and oxygen as scavengers. The butyl ions, $C_4H_9^+$, resulting from the reaction of $C_2H_5^+$ ions with ethylene, undergo skeletal isomerization, yielding ions with a tertiary structure. Tert-$C_4H_9^+$ ions are unreactive towards ethylene, the estimated rate constant for this reaction being $k \leq 10^{-12}$ cc/molecule.sec. (auth)

50338 RADIATION INDUCED OXIDATION OF ARSENIC TRIOXIDE. Colard, J.; Apers, D. J. (Univ., Louvain, Belgium). Radiochem. Radioanal. Lett.; 11: No. 2, 89-91(25 Aug 1972).

An analytical method based on electrophoresis and reactivation was developed for the study of radioinduced oxidation of arsenic trioxide. A complete separation of As(III) and As(V) after neutron irradiation is obtained by electrophoresis on short paper strips within 15 min. Ten days later the strips are exposed to neutrons and the induced activity is measured. (M.C.G.)

50339 GAMMA IRRADIATION OF THYMIDINE IN AERATED AQUEOUS SOLUTION. Cadet, J.; Teoule, R. (CEN, Grenoble, France). Tetrahedron Lett.; No. 31, 3225-8(Jul 1972). (In French).

Aerated aqueous solutions of thymidine (10^{-3}M, pH 6) were irradiated with doses of 150 to 610 krads from ^{60}Co γ radiation at 16°C and the radiolytic products separated by preparative chromatography on a thin layer of silica. The products are listed, together with their RF and G values, and their formation mechanisms discussed under the headings of pyrimidine ring hydroxylation and N-glycoside bond rupture. (UK)

50340 OXIDATION OF ALIPHATIC ALCOHOLS TO ALDEHYDES. Battaerd, Hendrick Adriaan Jacobus (to Imperial Chemical Industries). Australian Patent 405,329. 29 May 1969. Filed 21 Nov 1967.

Aliphatic alcohols were converted to aliphatic aldehydes by a process that involves γ irradiating an aliphatic alcohol with a source of high-energy radiation in the presence of a solid energy transfer catalyst such as CdO, ZnO, alpha-Al_2O_3, PbO, Pb_3O_4, Sb_2O_3, Bi_2O_3, V_2O_5, WO_3, MoO_3, CoO, or Cu_2O. (Australia)

50341 EFFECT OF REPETITION OF HEAT TREATMENTS ON THE GELATION OF POLYETHYLENE BY GAMMA RADIATION. 1. LOW DENSITY POLYETHYLENE. Tsunekawa, Yoshinori (Kobe Univ. of Mercantile Marine, Japan). Kobe Shosen Daigaku Kiyo. Dai-2-rui. Kokai, Kihan, Rigaku-hen; No. 19, 129-32(Mar 1972). (In Japanese).

The radicals induced by irradiation in polyethylene can remain trapped for long periods. Those radicals can be utilized readily in crosslinking when the polyethylene is heated and most crystallites have melted trapping the radicals. It may be expected, therefore, that repetition of heat treatments during irradiation increases the effectiveness of irradiation in producing crosslinking. Such effects were studied. (auth) (Japan)

50342 MOESSBAUER STUDY OF THE REDUCTION OF FERRICYANIDES BY ELECTRON IRRADIATION. Baggio-Saitovitch, E.; Raj, D.; Scorzelli, R.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 13, 179-88(1972).

In order to confirm the importance of the contribution of H radicals to the reduction mechanism, radiation effects in a series of iron(III) hexacyanides, some of which contained hydrogen in the form of water of crystallization and others that crystallized in anhydrous form, were compared. The main effect of the radiation was reduction of $Fe^{3+}(CN)_6^{3-}$ to $Fe^{2+}(CN)_6^{4-}$ in hydrated ferricyanides. The reduction yield was negligible in the anhydrous ferricyanides. These results support the assumption that the formation of hydrogen radicals is responsible for the reduction. (M.C.G.)

50343 KINETIC REGULARITIES OF RADIATION-INDUCED GRAFT POLYMERIZATION OF ACRYLIC ACID FROM THE GAS PHASE ON POLYPROPYLENE FIBERS. Malakhova, L. I.; Vlasov, A. V.; Mikhailov, N. V.; Tsetlin, B. L. (All Union Research Inst. for Artificial Fibers, Moscow. Inst. of Elemental Organic Compounds, Moscow). Vysokomol. Soedin., Ser. A; 14: No. 4, 751-5(Apr 1972). (In Russian).

The dependence of the radioinduced graft polymerization of acrylic acid on drawn polypropylene fibers on reaction conditions (dose, dose rate, temperature, vapor pressure, and sorption of monomer) was studied. Kinetic regularities of the process correspond to the usual regularities of radioinduced graft polymerization from the gas phase on polymer substrates. The anomalously high value of the total activation energy of gas-phase polymerization of acrylic acid and acrylonitrile on drawn fibers is due to the orientational nature of polymerization in these systems. (auth)

50344 LOW-TEMPERATURE RADIATION-INDUCED POLYMERIZATION OF CRYSTALLINE TETRAFLUOROETHYLENE. Bruk, M. A.; Chuiko, K. K.; Eroshina, L. V.; Aulov, V. A.; Abkin, A. D. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 14: No. 4, 794-800(Apr 1972). (In Russian).

For crystalline tetrafluoroethylene irradiated at 77°K the limiting of radio-induced polymerization at a small conversion degree, observed when determining the polymer yield after heating of irradiated samples, is accounted for by low-temperature post-polymerization occurring in heated samples. This reaction is initiated by cation-electron ion pairs in a shallow trap, whose accumulation in irradiated samples at doses about 0.5 Mrad. The polymerization in source, however, at 77°K occurs at a small apparent rate and is characterized by a linear dependence of the polymer yield on the dose (doses up to 110 Mrad were investigated). Additional evidence in favor of formation of polymer in source at 4.2°K was obtained. (auth)

50345 ELECTRON SPIN RESONANCE STUDIES OF THE FREE RADICALS FORMATION UPON γ-IRRADIATION OF COTTON CELLULOSE AND ITS DERIVATIVES. Khamidov, D. S.; Azizov, U. A.; Milinchuk, V. K.; Usmanov, Kh. U. Vysokomol. Soedin., Ser. A; 14: No. 4, 838-45(Apr 1972). (In Russian).

A study was made at various temperatures of the kinetics of free radical formation on γ irradiation of cotton, hydrolyzed, hydrated (cellophane) cellulose, and cellulose di- and triacetate. In cotton and hydrolyzed cellulose at 77°K G(R) is 0.7; in hydrated cellulose, 0.9. At 300°K in cotton cellulose G(R) is 2.0; in hydrolyzed cellulose, 1.0; in hydrated cellulose, 0.9. In cellulose di- and triacetate at 77°K G(R) is 1.7 and 1.8, respectively. A hyperfine structure (HFS) analysis showed two signals to be present in the spectrum consisting of 4 and 3 HFS lines. The triplet can be ascribed to any of the radicals formed during the abstraction of the CH_2OH group or hydrogen atoms from C_2, C_3, and C_4 with equivalent interaction of the unpaired electron with β-proton. The HFS of 4 lines with splitting ~19 e can be ascribed to the radicals formed during hydrogen abstraction from C_5. The ESR spectra of cellulose di- and triacetate γ-irradiated at 77°K are a superposition of an intensive doublet and a triplet. Probably, the doublet should be assigned to the free radicals with an unpaired electron localized at C_1. The spectrum of three lines can be assigned to the radicals formed during abstraction of hydrogen atoms from carbon atoms of the glucoside unit. (auth)

50346 HYPERFINE ANOMALY ARISING FROM THE NUCLEAR SPIN-FORBIDDEN TRANSITION, AND ABSOLUTE SIGN DETERMINATION OF THE ZERO-FIELD SPLITTING CONSTANT. Minakata, K.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). Mol. Phys.; 23: No. 6, 1115-31(Jun 1972).

It is found in the triplet ESR spectra of radical pairs in irradiated potassium deuterium fumarate that the hyperfine structure of the two transitions, $M_s = -1, 0$ and $M_s = 0, +1$, are entirely different. This anomaly is interpreted in terms of the forbidden transition arising from the mixing of the nuclear spin states by the anisotropic hyperfine interaction. The theory was developed for multiplet electron spin systems and includes the nuclear

Zeeman interaction, which is often neglected. The theoretical predictions are in good agreement with the observed separations and intensities of the anomalous hyperfine lines. In addition, it was found that since the forbidden lines of the electron spin multiplet system appear strongly only in transitions that include some specific electronic spin states, the anomalous features of the spectra make it possible to determine the absolute sign of the zero-field or hyperfine splitting constant, if the sign for one of them is known. Using this principle, attempts were made to determine the absolute sign of the zero-field splitting constant for a number of triplet ESR spectra that exhibit a hyperfine anomaly arising from the proposed mechanism. (auth)

50347 ADSORPTION OF HYDROGEN ON SILICA GEL IRRADIATED BY (n,γ) RADIATION OF A NUCLEAR REACTOR. Ermatov, S. E.; Bakhabov, M. V.; Tuseev, T. T. Vestn. Akad. Nauk Kaz. SSR; No. 12, 58-60(Dec 1971). (In Russian).

The kinetics of hydrogen adsorption by two types of irradiated silica gel were studied. The first set of experiments involved exposing silica gel to ^{60}Co γ radiation in doses from 1 to 10 MR immediately prior to the adsorption tests. In all samples H_2 adsorption equilibrium was nearly attained after 1 to 2 minutes. The second set of experiments began with exposing the silica gel in the vertical hole of a nuclear reactor for from 1 to 100 MR. Hydrogen adsorption equilibrium had not yet been attained even after several days in this case. In both sets of experiments larger radiation doses increased both adsorption rates and total quantities of hydrogen adsorbed. (K.S.W.)

50348 COATINGS FORMED FROM EPOXY RESINS MODIFIED BY UNSATURATED ACIDS. Blin, Marie Francoise; Gaussens, Gilbert; Lemaire, Francis (to Commissariat a l'-Energie Atomique). French Patent 2,087,289. 6 Dec 1971. Filed 13 May 1970. (In French).

A process for forming coatings with epoxy resin based paints and varnishes which have been modified by unsaturated carboxylic acids (e.g. methacrylic acid) and hardened by radiations is described. This cross-linking process consists of preparing an epoxy resin modified by reactions with the COOH group at the epoxy bridge positions and esterifying the hydroxyl groups of the resin. The resin is then directly applied to the substrate as a film having a thickness lying between 10 and 100 μ. The resin is dried by irradiation under vacuum. The irradiation is effected with an electron beam having an energy of between 10 and 100 keV. (France)

50349 FORMATION OF HIGHLY HYDROPHILIC DERIVATIVES OF POLY(VINYL ALCOHOL) BY IRRADIATION. Yoshitake, Toshihiko (Kuraray Co., Ltd., Kurashiki, Japan). Nippon Kagaku Kaishi; No. 7, 1309-12(Jul 1972). (In Japanese).

Aqueous solutions of poly(vinyl alcohol) (PVA) containing isopropyl alcohol, glycerol, or sucrose, were irradiated with high doses of γ-rays. After irradiation, water-swelling ratios and water-soluble fractions of the polymeric products were determined. When glycerol or sucrose was added, highly hydrophilic derivatives of PVA were formed. They were found to contain a few mole-percents of glycerol or sucrose. Intrinsic viscosities of these derivatives decreased at initial stages of irradiation and then increased to gelation. This may be explained by assuming that due to the formation of these derivatives intermolecular cross-linking of PVA was restrained. (auth)

50350 OXYGEN ATOM: A PRIMARY SPECIES IN IRRADIATED WATER. Brown, Weldon G.; Hart, Edwin J. (Argonne National Lab., Ill.). Radiat. Res.; 51: No. 2, 249-53(Aug 1972).

Evidence is presented supporting the hypothesis that a small but finite yield of O atoms results upon ^{60}Co γ-ray irradiation of liquid water. Ethylene, a specific product of the O + cyclopentene (CP) reaction, forms in irradiated aqueous CP solutions with a yield, G(C_2H_4) of 0.0023. G(C_2H_4) increases 12-fold in irradiated 4 M $NaClO_4$, a known source of aqueous O atoms. And verifying that the O atoms from H_2O and the ClO_4^- are the same, 0.3 M CH_3OH lowers G(C_2H_4) by the same fractional amount in the presence and absence of 4 M $NaClO_4$. (auth)

50351 USE OF ELECTRON ACCELERATOR IN THE CHEMICAL INDUSTRY. Dobo, J. (Mueanyagipari Kutato Intezet, Budapest). Izotoptechnika; 15: No. 2, 79-84(Feb 1972). (In Hungarian).

The use of the 2 MeV Van de Graaff electron accelerator of the Research Institute for Plastics for grafting polyethylene is described, and future perspectives are considered. (auth)

50352 NEGATIVE ION–MOLECULE REACTION IN NITROETHYLENE. Shiga, Tetsuo (Kyoto Univ.); Yamaoka, Hitoshi; Arakawa, Kazuo; Sugiura, Toshio. Bull. Chem. Soc. Jap.; 45: No. 7, 2065-9(Jul 1972).

The formation of negative ions and the negative ion–molecule reaction in nitroethylene by electron impact were studied. The nondissociative resonance electron capture of the nitroethylene molecule led to the formation of the molecular negative ion. The ionization efficiency curves and the appearance potentials of several fragment negative ions and the molecular negative ion were measured. The dimer negative ion of nitroethylene was found to be formed by the ion–molecule reaction between the molecular negative ion and a neutral nitroethylene molecule, and the rate constant of this ion–molecule reaction was estimated to be approximately 3.2×10^{-13} cc molecule^{-1} sec^{-1}. (auth)

50353 GAMMA-RAY-INDUCED POLYMERIZATION OF FLUORINE-CONTAINING CONJUGATED DIENE. Ito, Katsukiyo; Muramatsu, Hiroshige; Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Kobunshi Kagaku; 29: No. 325, 290-4(May 1972). (In Japanese).

The γ induced bulk polymerization of (hexafluorocyclopentenyl) ethylene (HCE), (2-chlorotetrafluorocyclopentenyl)ethylene (CHCE), (tetrafluorocyclobutenyl)ethylene (TCE), (2-chlorohexafluorocyclobutenyl)ethylene (CTCE), 1-(tetrafluorocyclobutenyl)-1-methylethylene (TCME), and 1-(2-chlorotetrafluorocyclobutenyl)-1-methylene (CTCME) at -21 to 25°C was investigated. The orders of reactivity in cyclopentenyl compounds and in cyclobutenyl compounds are CHCE $\gg$ HCE and CTCE $>$ TCE $\gg$ TCME $>$ CTCME respectively. The latter order shows that the substituted methyl group reduces the reactivity. HCE, CHCE, TCE, and CTCE were polymerized through 1,2-addition modes. TCME and CTCME were polymerized through 1,4-addition modes. Further, a kinetical consideration was made for the polymerization of CHCE, TCE, and CTCE. (auth)

50354 STUDY OF IRRADIATED ZEOLITES (NH_4Y AND HY). PART 1. STUDY OF ATOMIC HYDROGEN USING ESR. Abou-Kais, Antoine; Vedrine, J. C.; Massardier, Jean; Dalmai-Imelik, Gisele; Imelik, Boris (CNRS, Villeurbanne, France). J. Chim. Phys.; 69: No. 4, 561-9(Apr 1972). (In French).

The formation of trapped atomic hydrogen in zeolites (NH_4Y and HY) irradiated at 77°K with γ rays was studied using ESR. The width of the spectral lines due to trapped hydrogen atoms and their hyperfine coupling constant vary with increasing calcination temperature; different types of trapping site were identified. A particular type of trapping site is predominant with heated zeolite at temperatures not exceeding 200°C, which can be related to the existence of NH_4^+ ions. Another type of site is observed with samples heated between 200 and 500°C. This latter type of site is linked to the presence of OH acid groups. It was possible to establish a correlation between the trapped H and the Bronsted acidity of the zeolites. The ESR spectra present a homogeneous type saturation, the lines being of the Lorentz type. A mechanism for the formation of atomic hydrogen is proposed. A weak bond stabilization of between 1 and 2 kcal/mole^{-1} was measured. (France)

50355 CHARACTERISTICS OF RUBBERS OBTAINED FROM THE RADIATION-INDUCED CROSS-LINKING OF NATURAL LATEX. Veber, Andre (Societe Mapa-Fit, Les Lilas, France). Rev. Gen. Caout. Plast.; 49: No. 4, 299-301(Apr 1972). (In French).

Gamma irradiation was found to be an efficient crosslinking method. Substances such as carbon tetrachloride, oil, and sulfur were added in order to reduce the radiation dose necessary and in consequence the cost. It was also found necessary to control temperature. The rubbers obtained in this way presented good mechanical characteristics. (France)

50356 ESR OF HOT IONS: Zn(I), Cd(I), AND Hg(I) IN γ-IRRADIATED POTASSIUM TETRACYANO ZINCATE(II), CADMATE(II), AND MERCURATE(II). Isoya, Jun-Ichi; Fujiwara, Shizuo (Tokyo Univ.). Bull. Chem. Soc. Jap.; 45: No. 7, 2182-8 (Jul 1972).

It is known that x or γ irradiation of inorganic complexes produces hot ions which have lower valence states than the original ones and yet are sited in the regular crystalline array of the undamaged mother complexes. ESR study reveals that the hot ions of paramagnetic Zn(I), Cd(I), and Hg(I) complexes are formed by γ irradiation of $K_2[Zn(CN)_4]$, $K_2[Cd(CN)_4]$, and $K_2[Hg(CN)_4]$, respectively. Hyperfine structures of the ESR signals show that the Zn(I) and Cd(I) complexes have C_{3v} symmetry instead of T_d symmetry of the original complex, and Hg(I) complex has a slightly distorted C_{3v} symmetry. In Zn(I) complex, one of the four symmetry axes along Zn(II)–CN bondings is stretched. This occurs evenly with respect to each axis, resulting in the formation of four sites of the electron spins. For Cd(I) complexes, four species are produced as an irradiation product, where each species has four sites which are axially symmetric with respect to any one of the four Cd(II)–CN bondings. In Hg(I) complex, there exist twenty-four sites and the symmetry axis of each site lies along a direction slightly deviated from the original Hg(II)–CN bonding. From the behavior of the decay of ESR signal intensity at liquid nitrogen temperature, it is concluded that the stability is in the order Hg(I) > Cd(I) > Zn(I). (auth)

50357 STUDY OF IRRADIATED ZEOLITES (NH$_4$Y AND HY). PART 2. RELATION BETWEEN THE TRAPPED ATOMIC HYDROGEN AND THE HYDROXYL ACID GROUPS IN SOLIDS. Abou-Kais, Antoine; Massardier, Jean; Dalmai-Imelik, Gisele; Imelik, Boris (CNRS, Villeurbanne, France). J. Chim. Phys.; 69: No. 4, 570-3(Apr 1972). (In French).

The irradiation of acidic hydroxyl groups found in HY zeolites produces trapped atomic hydrogen. Two atomic hydrogen lines having widths of 1.25 and 3.6Gs and a hyperfine separation were detected. These lines are associated to the OH groups responsible for the ir absorption bands at 3550 and 3650 cm^{-1}. (France)

50358 TRANSIENT SPECIES IN THE PULSE RADIOLYSIS OF DIMETHYL SULPHOXIDE. Bensasson, R. (Univ., Paris, Orsay, France); Land, E. J. Chem. Phys. Lett.; 15: No. 2, 195-8(1 Aug 1972).

Four transient species were detected in the time scale 10^{-9} to 10 seconds following pulse radiolysis of dimethyl sulfoxide. Effects of additions of nitrous oxide, biphenyl, naphthalene, and pyrene on production of the transient species are discussed. (J.G.B.)

50359 DRY ELECTRONS STUDIED BY PULSE RADIOLYSIS. Cercek, B.; Micic, O. I. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Nature (London) Phys. Sci.; 238: No. 83, 74(31 Jul 1972).

A recent model for the radiolysis of water (Hamill, J. Phys. Chem. 73, 1341 (1969)) includes chemical reactions of the precursor of the hydrated electron, that is, the nonhydrated ("dry") electron, represented by e^-_{dry}. According to this model e^-_{dry} reacts with scavengers such as N_2O, Lewis acids, and acetone, but not with hydronium ions, $H_3O^+_{aq}$. In order to test this a pulse radiolysis study was made of the effect of $H_3O^+_{aq}$ on the yields of transient species from the reaction of e^-_{aq} and/or e^-_{dry} with acetic acid. If scavenging of e^-_{dry} increases with increasing solute concentration, the maximum extent by which the yield of a transient product can be decreased by $H_3O^+_{aq}$ will be greater at low than at high concentrations of the acetic acid. t-Butanol was added to scavenge hydroxy radicals. Hydrogen atoms could not interfere with the measurements since their reactions are slow. It was found that the extent by which the yield of a transient can be decreased by $H_3O^+_{aq}$ decreased with increasing acetic acid concentration. The results were in agreement with the recent model for the radiolysis of water, but contrary to what would be expected from the competition between acetic acid and $H_3O^+_{aq}$ for hydrated electrons. Reasons are given as to why the results cannot be explained by application of time-dependent rate constant theory. (UK)

50360 REACTION RATES OF ELECTRONS IN PICOSECOND PULSE RADIOLYSIS. Hayon, E. (Army Natick Labs., Mass.). Nature (London) Phys. Sci.; 238: No. 83, 76-7(31 Jul 1972).

Reference is made to studies by Hunt and others (J. Chem. Phys. 55, 530 (1971)) who used pulse radiolysis to study the reaction rate constants of hydrated electrons with solutes in the time range 20 to 350 ps and found evidence for existence of the dry electron e^-. The present investigation indicates that most of the differences in the rate constants for the reactions studied do not provide support for e^- reactions. Data for reaction rate constants of hydrated electrons with several solutes in aqueous solutions are compared. The results and arguments presented do not of themselves provide any evidence against the existence of the "dry electron," but they do weaken some of the previous arguments made in its favor. Furthermore, some of the implications made in regard to the reactivity of biological cells and tissues towards "dry" electrons are rendered no longer valid; this applies particularly to glycine and cystine. (J.G.B.)

50361 SIMULTANEOUS EFFECTS OF γ RADIATION AND TEMPERATURE ON THE ELECTROCONDUCTIVITY OF THE HYDROCARBON MIXTURE OF A GASOLINE FRACTION. Melikzade, M. M.; Kerimov, V. K.; Shkolnik, B. L. Azerb. Khim. Zh.; No. 4, 126-9(1971). (In Russian).

The combined effects of ^{60}Co γ radiation (1.6 × 10^4 g equiv of Ra) and temperature on a petroleum fraction boiling from 76 to 200°C (d_4^{20} = 0.7402, and n_D^{20} = 1.4190) were studied. Measurements of the electric conductivity were conducted over the temperature range 0 to 250°C. The specific conductivity of the gasoline fraction was a linear function of the radiation dose rate from 0 to 40 R/sec. The conductivity increased irregularly with temperature, both in the presence and in the absence of radiation. (K.S.W.)

50362 STUDY OF THE PARAMAGNETIC CENTRES PRODUCED BY RADIOLYSIS IN KCrO$_3$Cl. Debuyst, R.; Ladriere, J.; Apers, D. J.; Capron, P. C. (Univ., Louvain, Belgium). J. Inorg. Nucl. Chem.; 34: No. 9, 2705-12(Sep 1972).

Potassium chlorochromate single crystals which were irradiated at ambient temperature were analyzed by ESR spectroscopy. On the basis of the g values, some information on the hyperfine structure and the center orientation in the lattice, the existence of the radical CrO_3Cl^{2-} is postulated. (auth)

50363 TIME-DEPENDENT SCAVENGING OF TRAPPED ELECTRONS IN 2-METHYLTETRAHYDROFURAN GLASS AT 77°K. Miller, J. R.; Willard, John E. (Univ. of Wisconsin, Madison). J. Phys. Chem.; 76: No. 18, 2641-2(31 Aug 1972).

An experiment designed to observe directly the transfer of trapped electrons in the interval from 1 msec to 1 min for electrons produced by flash photolysis of naphthalenide anions in 2-methyltetrahydrofuran glass containing 3 × 10^{-2} M naphthalene at 87°K. The anions were generated by prior γ irradiation of the glass at 87°K. Results indicate that the decay observed following flash photolysis of MTHF containing an electron scavenger and similar decays observed on the minutes time scale following γ irradiation are apparently due to reaction of trapped electrons with the scavenger via quantum mechanical tunneling over distances up to 35 Å. (D.H.M.)

50364 LIFETIME OF TRIFLUOROMETHYL RADICAL IN AQUEOUS SOLUTION. Lilie, Jochen; Behar, D.; Sujdak, Richard J.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 76: No. 18, 2517-20(31 Aug 1972).

Radiolysis of aqueous solutions of CF_3Cl produces CF_3 radicals which can readily be trapped as the addition product to nitromethane anion. Intercomparison of the effects of scavengers on ESR signals of this adduct radical and on the production of fluoride ion indicates that CF_3 reacts with water with a period of ~30 msec. Conductometric pulse radiolysis studies in the presence of 1 mM methanol, where OH radicals are rapidly removed from the system, show that no significant hydrolysis of CF_3 occurs on the millisecond time scale. In the absence of methanol, however, secondary reactions which produce a large yield of HF occur at shorter times. This HF can be accounted for by reactions involving combination of CF_3 radicals with OH. It is expected that the CF_3OH produced from such a combination will eliminate HF rapidly. However, it also appears from the magnitude of the increase in conductivity that CF_2O must hydrolyze completely within the period of these conductivity experiments. From the limiting growth period at high doses the period of the initial hydrolysis of CF_2O is estimated to be ~10 μsec. (auth)

50365 YIELDS AND REACTIONS OF LOWEST EXCITED SINGLET AND TRIPLET STATES IN THE RADIOLYSIS OF NAPHTHALENE AND 1-METHYLNAPHTHALENE. Holroyd, R. A. (Brookhaven National Lab., Upton); Capellos, C. J. Phys. Chem.; 76: No. 18, 2485-91(31 Aug 1972).

The yields of the lowest excited singlet and triplet states in the pulse radiolysis of liquid naphthalene and 1-methylnaphthalene were determined by measuring the triplet state absorption under various conditions. The yield of the triplet is enhanced by the addition of benzophenone and reduced by carbon tetrachloride. Both of these solutes quench the fluorescence by approximately 50% at 2 mM. The results are interpreted in terms of excitation transfer. The yields of the lowest states formed by ion recombination and by direct excitation in naphthalene are $G(^3N^*) = 3.8$, $G(^1N^*) = 2.4$; and in 1-methylnaphthalene $G(^3M^*) = 3.3$, $G(^1M^*) = 2.7$. The results provide a measure of the relative importance of various modes of excitation in radiolysis. Intersystem crossing from the excimer in 1-methylnaphthalene occurs with comparable efficiency as a dilute solution at 25°. However at 85° the intersystem crossing efficiency is reduced to 6% in molten naphthalene and 17% in methylnaphthalene. The decrease in lifetime of fluorescence at higher temperatures is shown not to be due to enhanced intersystem crossing but to a faster rate of internal conversion. (auth)

50366 RADIATION-CHEMICAL PARTIAL OXIDATION OF CYCLOHEXANE. II. EFFECT OF SOME PROCESS PARAMETERS. Guetlbauer, F. (Reaktorzentrums, Seibersdorf, Austria); Hofmann, Hd.; Corsepius, H.; Proksch, E. Atomkernenergie; 20: No. 1, 71-4(1972).

The effect of several process parameters on the radiation-chemical partial oxidation of cyclohexane was studied at temperatures of about 140°C. Static tests were carried out in glass vessels to determine the influence of different catalysts and chemical additives. For continuous processing, a one-phase apparatus was evaluated as oxidation unit, and then, for the sake of comparison, a gassing apparatus with a two-phase was studied. Because of the strong effect of the oxygen concentration rate on radiation-chemical chain initiation, a one-phase apparatus (100% oxygen, 60 atm/gauge) offered more favorable conditions for partial oxidation under irradiation than a gassing apparatus. It was possible to improve oxidation reaction conditions by adapting the dose rate of the radiation field to the oxygen concentration rate in the reactor, as well as by applying a two-stage oxidation process. In radiation-chemical/thermal partial oxidation the formation of secondary products, e.g., n-pentanol, was checked to a great extent in the presence of a sufficient amount of oxygen. (auth)

50367 HIGH-VACUUM SORPTION AGGREGATE FOR RADIATION-CHEMICAL INVESTIGATIONS. Maslov, B. V.; Gol'din, V. A.; Galich, L. M. (Scientific-Research Physical-Chemical Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1733-5(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 131-3(1971).

An investigation of the effect of γ radiation from ^{60}Co on the operation of a zeolite sorption vacuum aggregate at dosage powers of up to 7.2 mR/h and at sorbent radiation doses of up to 500 mR was investigated. The feasibility of using a portable two-stage vacuum sorption aggregate for performing radiation-chemical experiments under conditions of a high vacuum under intense γ irradiation was demonstrated. (auth)

50368 SPECIFIC SURFACE AREA OF POWDERY POLYETHYLENE OBTAINED BY RADIATION PROCESS. Sugo, Takanobu; Takehisa, Masaaki (Japan Atomic Energy Research Inst., Takasaki). Zairyo; 21: No. 225, 524-7(Jan 1972). (In Japanese).

Fine powdery polyethylene with extremely high specific surface area can be produced by polymerization of ethylene induced by radiation at lower temperatures than the melting point of the polymer in bulk or in the presence of aqueous tert-butanol. The specific surface area of the polymer is mainly determined by the polymerization temperature. At a polymerization temperature of 30°C, the specific surface area exceeds 100 m^2/g, while at 90°C the specific surface area decreases to 20 m^2/g. When the polyethylene slurry is obtained by polymerization in the presence of tert-butanol, and is dried as it is, the polymer has small surface area. When the drying is carried out after substitution of butanol for water, the surface area of the polymer increases to the above described values. The highly defective nature of fine structure of the polymer has been reported based on x-ray diffraction and NMR measurement. The fine structure must be closely connected with the large specific surface area. The measurement of pore distribution of the polymer by isothermal capillary condensation of liquid nitrogen indicated the presence of pores having a peak radius of less than 100 Å. The pores easily disappear on annealing at a moderate temperature. The presence of hexane vapor accelerated the annealing. The specific surface area measured by nitrogen adsorption by the use of the BET equation coincides well with the value calculated from the pore volume distribution by assuming that the pore is a cylindrical capillary. These kinds of polymer tend to be deformed easily by external stress, and they are useful materials for cold forging. (auth) (Japan)

50369 POSSIBILITY OF METALLOCENES AS CHARGE SCAVENGERS. Ling, A. Campbell (West Virginia Univ., Morgantown). J. Inorg. Nucl. Chem.; 34: No. 9, 2978-80 (Sep 1972).

The relatively low ionization potential of ferrocene (ca. 7.6 eV) and the stability of the ferricenium ion Cp_2Fe^+ might indicate that this compound, and other analogous metallocenes, could function as a positive charge scavenger. To test this hypothesis, ferrocene and nickelocene solutions in glassy hydrocarbon matrices were subjected to gamma radiolysis from a cobalt-60 source and then examined via uv-visible and ESR spectroscopic techniques. It is concluded that in this system under the conditions of the experiment, no positive charge scavenging takes place by either ferrocene or nickelocene. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 50669 and 50778.

50370 VORKOMMNISSE UND STRAHLENUNFAELLE IN KERNTECHNISCHEN ANLAGEN. (Radiation Incidents and Accidents in Nuclear Installations). Schulz, Erich H. Munich; Verlag Karl Thiemig KG (1966). 425p. DM 128.-.

Data from fifteen countries for the years 1943 through 1963 were analyzed. The data originate from construction and operation of nuclear reactors and all types of critical assemblies as well as from uranium and fissionable fuel chemistry. Also included are incidents involving particle accelerators. Analysis of transportation data shows that most of the incidents occur at locations of send-off and receipt, and not during actual transfer. Also compiled are durations of shutdown, extent of decontamination procedures, and the costs involved. Included in the survey are incidents in German installations. Special chapters are devoted to the nuclear power programs of ten industrial nations, compensation for radiation injuries, repair of nuclear installations, criticality control in radiochemistry, and radiation incidents in x-ray facilities. (H.B.G.)

Hot-Atom Chemistry

Refer also to abstract 50356.

50371 (CEA-R-4346) STUDY OF CHEMICAL EFFECTS RESULTING FROM (n,γ) AND (I.T.) NUCLEAR REACTIONS IN LIQUID AND SOLID PHASE DIBROMOETHANES. Grillet, Serge (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1972. 251p. (In French). Dep. NTIS (U.S. Sales Only).

Thesis. Submitted to Univ. of Paris, France.

1,2-dibromoethane and 1,1-dibromoethane were irradiated with thermal neutrons and the total and fractional organic yields of ^{80m}Br and ^{82}Br were determined as a function of the concentration of the Br added. Observation of scavenger, nuclear activation, and phase effects enabled the formation schemes of the different species of radioactive product to be defined. The results confirm the fact that the breaking down of the C−Br and C−C bonds necessitates a kinetic energy which can also be supplied by ^{82}Br and ^{80m}Br, the efficiency of the ^{80m}Br being higher. Preferential substitution of the hydrogen atoms occurs after the isomeric transition, thus favoring the ^{82}Br yield. Studies of the ^{79}Br(n,γ)^{80m}Br reaction in the 1,2-dibromoethane−bromine solid mixtures demonstrate the existence of a close correspondence between the variation in the total organic yield and the phase diagram. This relation is confirmed by the effects of the ^{80m}Br (I.T.) ^{80}Br process in different systems. As a result, the validity of the solid phase scavenger method is limited although it demonstrates that the variations observed arise generally from an increased rigidity of the crystalline lattice rather than a temperature effect. (auth)

50372 HOT-ATOM REACTIONS OF IODINE IN THE LIQUID PHASE INDUCED BY X-RAY RESONANCE ABSORPTION. Diehn, Bodo; Thomas, V. George (Univ. of Toledo). Contract AT (11-1)-1728. J. Phys. Chem.; 76: No. 18, 2639-41(31 Aug 1972).

Evidence is reported for hot-atom reactions of iodine following low-energy x irradiation of liquid iodobenzene. The product spectrum generated upon irradiation of a degassed sample of liquid iodobenzene consisted of benzene, iodine, iodobenzene, the o-, m-, and p-diiodobenzenes, biphenyl, and the o-, m-, and p-iodobiphenyls. Upon irradiation in the presence of air, phenol was found as an additional product. No change in the product spectrum was found when a 4.7 mol % solution of iodine in iodobenzene was irradiated instead of pure iodobenzene. No products whatever were found upon irradiation of 2.1 mol % solution of iodine in benzene at 40 keV with a dose of 1.4 Mrads. (D.H.M.)

50373 KINETIC ANALYSIS AND MECHANISM OF ^{38}Cl AND ^{82}Br RECOIL REACTIONS IN $K_2[ReBr_6]/K_2[ReCl_6]$ MIXED CRYSTALS. Roessler, K.; Otterbach, J.; Stoecklin, G. (Kerforschungsanlage, Juelich, Ger.). J. Phys. Chem.; 76: No. 18, 2499-2506 (31 Aug 1972).

The solid state reactions occurring during energy loss of (n,γ)-produced ^{38}Cl and ^{82}Br recoils were studied in $K_2[ReBr_6]/K_2[ReCl_6]$ mixed crystals. The product yields (free radiohalide and monosubstituted complexes) were determined as a function of the mixed crystal composition. The yield curves obtained can be described by zero-, first-, and second-order terms, corresponding to three basic mechanisms: (1) correlated recombination (primary retention), (2) direct substitution, and (3) multistep process involving ligand vacancy exchange followed by combination. From the kinetic analysis the number of ligand vacancies required for product formation was calculated to be 2.37 γ and 0.66 γ' per recoil event for ^{38}Cl and ^{82}Br, respectively (γ,γ' = mole fraction of parent complex). Recoil ranges of ≥15 and about 10 Å were estimated for the primary atoms ^{38}Cl and ^{82}Br, respectively. Thermal annealing, which was also studied as a function of the mixed crystal composition, exclusively leads to reformation of the labeled parent complex by correlated ($^{82}Br^-$) and noncorrelated ($^{37}Cl^-$) combination with a ligand vacancy. (auth)

50374 HOT-ATOM CHEMISTRY OF ^{14}C IN SOLID BENZENE AT KINETIC ENERGIES AT OR BELOW 5 ELECTRON VOLTS. Lintermans, Jacques; Erwin, Wallace; Lemmon, Richard M. (Univ. of California, Berkeley). J. Phys. Chem.; 76: No. 18, 2521-4(31 Aug 1972).

The yields of seven major hydrocarbon products from the irradiation of solid benzene with accelerated ^{14}C ions were determined at very low kinetic energies, namely, down to 2 eV. The ultimate fate of the irradiating carbon ions was determined by chemical degradation of the products to reveal the percent of ^{14}C activity at a given position in the molecule. This work has shown (a) throughout the 5000 to 2-eV energy range, an essentially constant yield of benzene (about 3 to 4% of the irradiating $^{14}C^+$ ions), (b) a decrease in the yields of toluene, cycloheptatriene, and phenylacetylene as one goes from 100 down to 2 eV, (c) an increase in the yields of phenylcycloheptatriene and biphenyl when the 5 to 2 eV-energy range is reached, and (d) the appearance of maximum activity in the phenyl groups of toluene and diphenylmethane at about 5 eV. These results suggest the mechanisms involved in the formations of these products. (auth)

Properties of Radioactive Materials

Refer also to abstracts 50284 and 50977.

50375 (RFP-Trans–109) CHEMICAL REACTIONS IN MELTED SALTS. PART 1. Landresse, G. Translated for Dow Chemical Co., Denver, Colo., from Ind. Chim. Belge.; 36: 843-51(1971). 21p. Dep. NTIS.

In this review article molten salt reactions are divided into three parts: acid-base plus double decomposition reactions, precipitation reactions, and oxidation-reduction reactions. The Lux–Flood concept of acid-base reactions is applied wherein Base $\rightleftharpoons$ Acid + O^{2-} represents an equilibrium reaction involving a conjugate acid and base. Discussion of dissolution of metal oxides includes UO_2, UO_3, and ThO_2 in addition to a number of common oxides. Reactions with exchange of O^{2-} are grouped according to whether or not the solvent participates. Review of precipitation studies includes specific studies of precipitation of UO_2 from dissolved UO_2^{2+} and UF_4, reactions between BrO_3^- and U(VI), Np(V), and Np(VI) in a $LiNO_3-KNO_3$ melt, and a separation of Pu from Am by precipitating PuO_2 by treatment with an $Ar-O_2$ mixture, which leaves Am in solution. (62 references) (K.S.W.)

50376 THERMODYNAMICS OF Am(III)-NITRILOTRIACETIC ACID COMPLEXES. Eberle, S. H.; Sabau, C. S. (Univ., Karlsruhe, Ger.). Radiochem. Radioanal. Lett.; 11: No. 2, 77-87(25 Aug 1972).

The stability constants of nitrilotriacetate complexes of trivalent americium were determined spectrophotometrically at six temperatures. From the temperature dependence of the stability constants, the thermodynamic functions were calculated. The values found are: $\Delta H_1 = 0.7 \pm 0.5$ kcal/mol, $\Delta S_1 = 56.1 \pm 0.2$ e.u., $\Delta G_1 = -16.30 \pm 0.04$ kcal/mol, $\Delta H_2 = -5.7 \pm 0.8$ kcal/mol, $\Delta S_2 = 22.3 \pm 3$ e.u., $\Delta G_2 = -12.32 \pm 0.09$ kcal/mol. (auth)

50377 STUDY OF THE STATE OF RUTHENIUM(III) IN METHANOL BY ADSORPTION ON GLASS AND POLY(TETRAFLUOROETHYLENE). Lebedev, R. A.; Yurchenko, L. M.; Filatov, E. S.; Nesmeyanov, A. N. (Moscow State Univ.). Radiochem. Radioanal. Lett.; 11: No. 2, 119-27(25 Aug 1972).

By investigating the adsorption of ^{106}Ru(III) from methanol on glass and poly(tetrafluorethylene), the pH ranges were determined in which the formation of differently charged ruthenium species is preferred. Starting from the assumption that an acid-base equilibrium exists, it is suggested that condensation results in positively and negatively charged polynuclear ions. (auth)

50378 STUDY OF THE STATE OF RUTHENIUM(III) IN METHANOL BY ELECTRODIALYSIS AND DIFFUSION METHODS. Yurchenko, L. M.; Filatov, E. S.; Nesmeyanov, A. N. (Moscow State Univ.). Radiochem. Radioanal. Lett.; 11: No. 2, 129-36 (25 Aug 1972).

The behavior of ^{106}Ru(III) in methanol, as a function of the pH of the solution, was studied using electrodialysis and diffusion methods. It was found that, in the pH range from 0.3 to 5.0, the relative migration velocities of ^{106}Ru(III) to the anode and cathode differ substantially. The dependence of the diffusion coefficients, the particle radii, and molecular weights on the pH was investigated. On the basis of the results, it is suggested that at pH values higher than 5, ^{106}Ru(III) exists in methanolic solutions in the form of condensed polynuclear ions. (auth)

50379 OXYCHLORIDES OF PENTA- AND TETRAVALENT URANIUM UO_2Cl AND $UOCl_2$. Eliseev, S. S.; Glukhov, I. A.; Vozhdaeva, E. E. (Inst. of Chemistry, Stalinabad, USSR). Zh. Neorg. Khim.; 17: No. 5, 1203-8(May 1972). (In Russian).

A simple and practical method for obtaining the little-known U oxychlorides UO_2Cl and $UOCl_2$ was developed. The reactions involved were induced by heating mixtures of UO_3 and $MoOCl_3$, the reactions being $UO_3 + MoOCl_3 \rightarrow UO_2Cl + MoO_2Cl_2$ and $UO_3 + 2MoOCl_3 \rightarrow UOCl_2 + 2MoO_2Cl_2$. Thermograms were prepared from various molar ratios of the starting materials, heated to as high as 352°C, and were used to explain the chemistry of the reactions. (K.S.W.)

50380 NORMAL VIBRATIONS OF THE ION $[UO_2Br_4]^{2-}$. Bystrov, D. S.; Vdovenko, V. M.; Ladygin, I. N.; Suglobov, D. N. Zh. Neorg. Khim.; 17: No. 5, 1416-22(May 1972). (In Russian).

An analysis was conducted on the normal vibrations of the $[UO_2Br_4]^{2-}$ ion for the great number of solutions to the inverse vibrational problem. Replacement of ^{18}O in the ion, allowing for an error in frequency determination, is noneffective for determining the potential function of the uranyl. (tr-auth)

50381 MOESSBAUER AND MAGNETIC SUSCEPTIBILITY STUDIES OF URANIUM(III), URANIUM(IV), NEPTUNIUM(III), AND NEPTUNIUM(IV) COMPOUNDS WITH THE CYCLOPENTADIENE ION. Karraker, D. G.; Stone, J. A. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Inorg. Chem.; 11: No. 8, 1742-6(Aug 1972).

Mössbauer spectra of $NpCp_4$, $NpCp_3Cl$, and $NpCp_3 \cdot 3THF$ show isomer shifts indicative of covalent Np(IV)–Cp bonds (Cp = $C_5H_5^-$ ion) for $NpCp_4$ and $NpCp_3Cl$ and ionic Np(III)–Cp bond for $NpCp_3 \cdot 3THF$. Quadrupole splitting of the Mössbauer spectrum of Np^{4+} in $NpCp_4$ suggests a site of axial symmetry for the Np^{4+} ion. The magnetic susceptibilities of UCp_4, UCp_3Cl, $UCp_3 \cdot THF$, $NpCp_3Cl$, and $NpCp_3 \cdot 3THF$ were measured from 2.5 to 100°K. Interpretation of magnetic susceptibilities in terms of crystalline field predictions indicates that U^{4+} and Np^{4+} in $UCp_3 \cdot THF$, UCp_3Cl, and $NpCp_3Cl$ are in sites of low symmetry; U^{4+} in UCp_4 and Np^{4+} in $NpCp_4$ are in sites with less than T_d symmetry, but having a threefold axis; and the Np^{3+} ion in $NpCp_3 \cdot 3THF$ is in a site descended from O_h symmetry. (auth)

50382 COPRECIPITATION OF URANIUM(VI) WITH THE HYDROXIDES OF IRON(III), ZIRCONIUM, MANGANESE(IV), AND MAGNESIUM. Novikov, A. I.; Gordeeva, L. N. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 12-17(1972).

Translated from Radiokhimiya; 14: No. 1, 14-20(1972).

The precipitation, sorption by surface of the carrier, and coprecipitation of 1 mg and 50 μg uranium(VI) with iron(III), zirconium(IV), manganese(IV), and magnesium hydroxides were studied as a function of the pH of the medium in solutions of ammonium nitrate, sulfate, and bicarbonate, sodium perchlorate, and in solutions containing hydrogen peroxide. The coprecipitation and sorption began in the region of hydrolysis of uranyl ions, increased as they were polymerized, and decreased when the coordination saturation ions $UO_2(CO_3)_3^{4-}$, $UO_2(O_2)_2^{4-}$, and UO_4^{2-} anions were formed. The concentration of U(VI) by coprecipitation with hydroxides in a 1M solution of NH_4NO_3 occurred at pH = 6 to 8.5 (Fe hydroxide), 5.5 to 7.0 (Zr hydroxide), and 3 to 8 (Mn (IV) hydroxide). The regions of concentration of uranium by coprecipitation with hydroxides, in the presence of sulfate and carbonate ions in solutions containing hydrogen peroxide, were established. The separation of uranium from carriers in the presence of carbonates occurs at pH > 7.5 (Fe hydroxide) and pH > 9 (Mn (IV) hydroxide). In hydrogen peroxide solutions uranium is separated from Fe and Mg hydroxides at pH > 13.5. (auth)

50383 FORMAL POTENTIALS OF THE COUPLE Np(VII)–Np(VI) AND Pu(VII)–Pu(VI) IN AQUEOUS SOLUTIONS WITH A HIGH CONCENTRATION OF ALKALI. Peretrukhin, V. F.; Krot, N. N.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 68-72(1972).

Translated from Radiokhimiya; 14: No. 1, 72-7(1972).

The formal potentials of the couples Np(VII)–Np(VI) and Pu (VII)–Pu(VI) in solutions of 1 to 14 M NaOH were measured. It was shown that from 1 to 14 M NaOH the potentials of neptunium and plutonium couples decrease from 0.589 to 0.133 V and from 0.849 to 0.395 V, respectively. It was shown that Np(VII) is thermodynamically stable in aqueous solutions at alkali concentrations above 6 M, while Pu(VII) is unstable in the entire investigated concentration interval (1 to 14 M NaOH). The poor reproducibility of the potential of the platinum electrode in dilute alkaline solution of Pu(VII) and Pu(VI) is explained by the evolution of oxygen at the electrode as a result of the high potential created by the heptavalent plutonium. (auth)

50384 INVESTIGATIONS OF REDOX REACTIONS OF THE ACTINIDE ELEMENTS. XV. KINETICS OF THE REACTIONS OF URANIUM(IV) WITH IRON(III) AND NEPTUNIUM(IV) WITH NEPTUNIUM(VI) IN AQUEOUS ALCOHOL SOLUTIONS. Ryokv, A. G.; Vasil'ev, V. Ya.; Timofeev, G. A.; Frolova, L. M. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 73-8(1972).

Translated from Radiokhimiya; 14: No. 1, 77-83(1972).

The rate of neptunium–neptunium and uranium–iron cation–cation reactions of the type of $M^{4+}X^{m+} \rightarrow MO_2^+ + X^{(m-1)+}$ in aqueous alcohol solutions is a complex function of the composition of the solvent. The shape of the curves of k'_{obs} versus C_{ROH} differs for methanol and ethanol solutions. The increase in the rate of the reactions $M^{4+} + X^{m+}$ with decreasing macroscopic dielectric constant of the solvent contradicts the concepts of a substantial contribution of coulombic interactions to the free energy of activation of ionic redox reactions. There is a direct proportionality between the free energy of activation of reactions of the type of $M^{4+} + X^{m+}$ and the donor capacity (effective ionization potential) of the mixed solvent, which agrees with the theories of ionic redox reactions, assuming charge transfer from one ion reagent to another along the chain of solvent molecules. The formation of hydrolyzed forms of uranium(IV) and neptunium(IV) leads to a decrease in the rate of reactions of the type of $M^{4+} + X^{m+}$. The rate of reactions of the type of $M^{4+} + X^{m+}$ in aqueous alcohol solutions is determined by the effective ionization potential of the solvent and by the degree of formation of hydrolyzed forms of M(IV). (auth)

50385 THERMODYNAMIC PROPERTIES OF FRANCIUM IN THE CONDENSED STATE. Ivanova, L. I. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 79-83(1972).

Translated from Radiokhimiya; 14: No. 1, 83-8(1972).

The thermodynamic properties of francium in the condensed state were calculated by the method of equalization according to the data for potassium, rubidium, and cesium. (auth)

50386 HYDROLYSIS OF THORIUM NITRATE. Pershin, A. S. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 84-9(1972).

Translated from Radiokhimiya; 14: No. 1, 88-94(1972).

Data from potentiometric measurements on the hydrolysis of thorium nitrate at low OH/Th ratios are shown to be most reliably explained by the hypothesis of formation of thorium hydroxide. Data on ultrafiltration showed that the hydrolysis products formed are not retained by a cellophane filter. Adsorption trapping of hydrolysis products leads to complete disappearance of the increase in OH^- ions after dilution. (auth)

50387 ULTRAHEAVY ELEMENTS. SOME PHYSICOCHEMICAL PROPERTIES OF ELEMENT 114. Chaikhorskii, A. A. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 119-20(1972).

Translated from Radiokhimiya; 14: No. 1, 122-3(1972).

Some physicochemical properties of element 114, obtained by extrapolation considering the role of the radial quantum number are presented. It was concluded that searches for the element should be conducted in minerals and rocks of the corresponding element analog and in sites of their occurrence. (M.C.G.)

50388 SOLID COMPOUNDS OF PLUTONIUM(VII). Zakharova, F. A.; Orlova, M. M.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 121-2(1972).

Translated from Radiokhimiya; 14: No. 1, 123-5(1972).

An attempt was made to precipitate plutonium(VII) with the complex ions $[Co(NH_3)_6]^{3+}$ and $[Pt(NH_3)_5Cl]^{3+}$. Analyses indicated a formula of $[Co(NH_3)_6]PuO_5 \cdot 3H_2O$ and a yield of 90.3% or a formula of $[Pt(NH_3)_5Cl]PuO_5 \cdot 3H_2O$. (M.C.G.)

50389 STABILITY CONSTANTS OF COMPLEXES OF THE RARE EARTH ELEMENTS AND THORIUM WITH DI(2-ETHYLHEXYL) PHOSPHORIC ACID. Guseva, N. N.; Sklenskaya, E. V.; Karapet'yants, M. Kh.; Mikhailichenko, A. I. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 132-4(1972).

Translated from Radiokhimiya; 14: No. 1, 132-4(1972).

The stability constants of complexes of rare earths (LnA^{2+}) and thorium ($ThOHA^{2+}$) with DEHPA were determined by a kinetic method. The values of log β at an ionic strength $\mu = 0.02$ (acetate buffer), pH = 5.00, and t = 25°C are equal to: La 4.42, Ce 4.54, Pr 4.60, Nd 4.65, Sm 4.87, Eu 4.92, Gd 5.03, Tb 5.12, Dy 5.18, Ho 5.28, Er 5.40, Tm 5.45, Yb 5.56, Lu 5.71, and Th 6.45 (error in the values less than ±0.1). The stability constant for the complex of Pm with DEHPA was calculated by interpolation and according to a method of comparative calculation: $\log \beta_{PmA^{2+}} = 4.75 \pm 0.1$. (auth)

50390 INFRARED AND ELECTRONIC SPECTRA OF THE TECHNETIUM OXY-COMPOUNDS. Baluka, M.; Hanuza, J.; Jezowska-Trzebiatowska, B. (Inst. of Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 3, 271-8(1972).

The infrared and electronic (uv and vis regions) spectra of the technetium oxy-compounds of the formulas TcO_4^-, $[TcOCl_5]^{2-}$, and $[TcO_2en_2]^+$ were examined. The determined electronic and oscillation transitions were assigned to the particular bands. The results obtained were used in estimating the technetium–oxygen bond length in the examined oxy-complexes. (auth)

50391 STUDY OF THE AFTEREFFECTS OF A CONVERTED ISOMERIC TRANSITION IN FROZEN TIN-CONTAINING SOLUTIONS BY THE MOESSBAUER METHOD. Bondarevskii, S. I.; Tarasov, V. A. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 172-3(1972).

Translated from Radiokhimiya; 14: No. 1, 162-4(1972).

Studies were made on frozen solutions of stannous chloride crystal hydrate in HCl, methanol, and acetone. The $SuCl_2 \cdot 2H_2O$ was labeled with the 250-day isomer $^{119*}Sn$. An appreciable influence of the chemical surroundings on the forms of stabilization of Moessbauer atoms was detected. The observed broadening of the lines in the emission spectra is evidence of some differences in the local surroundings of the individual tin atoms undergoing a converted isomeric transition. (M.C.G.)

50392 USE OF SELECTIVE SORPTION METHODS FOR THE REMOVAL OF THE HIGH-ACTIVITY COMPONENTS OF NEUTRON-ACTIVATED BIOLOGICAL SAMPLES. Toeroek, Gabor; Foti, Gyoergy; Nagy, Lajos Gyoergy; Toth, Tibor; Feuer, Laszlo. Magy. Kem. Foly.; 78: No. 6, 277-8(May 1972). (In Hungarian).

Hydrated antimony pentoxide, zirconium phosphate, and titanium phosphate were prepared as selective adsorbents for the elimination of high-activity components in neutron-activated biological samples. Decontamination factors better than 10^{-4}, 10^{-3}, and 10^{-2} were obtained for ^{24}Na, ^{32}P, and ^{42}K retentions, respectively. The adsorptive and chromatographic properties and other characteristics of these preparations were investigated to clarify the sorption mechanism. (auth)

50393 BREAKDOWN OF ETHYLENEDIAMINETETRAACETATE IONS IN THE PRESENCE OF NEPTUNIUM(V). Blokhin, V. I.; Bukhtiyarova, T. N.; Krot, N. N.; Gel'man, A. D. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 3, 505-7(Mar 1972). (In Russian).

The destruction of ethylenediaminetetraacetate (EDTA) in the presence of Np(V) was studied. Np(V) was prepared by reducing neptunyl ion with $NaNO_2$, and subsequently confirmed spectrophotometrically. The "half-life" of EDTA was measured at various pH values and at 40, 50, and 60°C for Np(V) concentrations ranging from 0.7×10^{-3} to 2.75×10^{-3} M. The rate of decomposition of EDTA as catalyzed by Np(V) was a function of pH, temperature, reagent concentration, and oxygen content of the solution. (K.S.W.)

50394 INVESTIGATIONS OF REDOX REACTIONS OF THE ACTINIDE ELEMENTS. XVI. KINETICS OF THE REACTION OF NEPTUNIUM(IV)–IRON(III) AND NEPTUNIUM(V)–IRON(II) IN AQUEOUS ALCOHOL SOLUTIONS. Rykov, A. G.; Andreichuk, N. N.; Timofeev, G. A.; Frolova, L. M. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 123-4(1972).

Translated from Radiokhimiya; 14: No. 1, 125-6(1972).

Kinetic measurements were performed by a spectrophotometric method at alcohol concentrations from 0 to 75 mole%. The rate of the forward reaction Np(IV) + Fe(III) increased sharply with increasing concentration of alcohol, but changing the composition had little effect on the rate of the reverse reaction Np(V) + Fe(II). The cause of this difference was concluded to be the different processes (electron transfer vs hole transfer) that determine the rate. (M.C.G.)

50395 KINETICS OF THE REACTION OF NEPTUNIUM(IV)–NEPTUNIUM(VI) IN TRIBUTYL PHOSPHATE. Frolova, L. M.; Timofeev, G. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 127-8(1972).

Translated from Radiokhimiya; 14: No. 1, 128-9(1972).

The reaction kinetics were investigated by a spectroscopic method. Results indicated that the reaction is irreversible with a total second order (first with respect to concentration of each of the cation reactants). The rate was inversely proportional to the total acidity. (M.C.G.)

50396 STANDARD ENTHALPIES OF FORMATION OF URANIUM(IV) SULFATE TETRAHYDRATE AND OCTAHYDRATE. Vidavskii, L. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl); 14: No. 1, 129-31(1972).

Translated from Radiokhimiya; 14: No. 1, 129-31(1972).

Data obtained in previous studies were used to calculate the enthalpies. Values are $\Delta H^0_{f298.15°C}\,U(SO_4)_2 \cdot 4H_2O = -836.3 \pm 2.0$ kcal/mole and $\Delta H^0_{f298.15°C}\,U(SO_4)_2 \cdot 8H_2O_{cr} = -1117.8 \pm 2.0$ kcal/mole. (M.C.G.)

50397 PROTON ACCEPTOR PROPERTIES OF NEUTRAL COMPLEXES OF URANYL AND THORIUM. Vdovenko, V. M.; Kovaleva, T. V.; Kanevskaya, N. A.; Statsevich, V. P.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 135-7(1972).

Translated from Radiokhimiya; 14: No. 1, 134-6(1972).

The shifts of the frequency υ_{OH} of phenol in its interaction with neutral complexes of uranyl and thorium were measured. Compounds of uranyl chloride and nitrate and thorium nitrate with TBP, TBPO, and TOPO, were used as the neutral complexes. The complexes formed a sufficiently strong H-bond with phenol; thus the complexes are polar and have centers carrying a negative charge. The value of $\Delta\upsilon_{OH}$ and, consequently, the value of the negative charge depend on the nature of the anion and neutral ligand. The proton acceptor centers in the complex are anions. (M.C.G.)

50398 INVESTIGATIONS OF REDOX REACTIONS OF THE ACTINIDE ELEMENTS. XVII. KINETICS OF THE REACTION URANIUM(IV)–IRON(III) AND NEPTUNIUM(IV)–NEPTUNIUM(VI) IN WATER–ACETONE MIXTURES. Rykov, A. G.; Timofeev, G. A.; Frolova, L. M. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 125-6(1972).

Translated from Radiokhimiya; 14: No. 1, 126-7(1972).

Kinetic measurements were conducted by differential potentiometric [uranium(IV)–iron(III) reaction] and spectrophotometric [neptunium(IV)–neptunium(VI) reaction] methods. Curves of the rate constant versus the composition of the solvent had distinct maxima. The formation of hydrolyzed forms of the cation-reducing agent led to a decrease in the rate of redox reactions. (M.C.G.)

50399 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XIII. RELATIONSHIP OF THE STRUCTURE AND SELECTIVITY OF CHELATE COMPLEXES WITH THE ADDITIVITY OF THE STRENGTH OF THE INDIVIDUAL RINGS. Shalinets, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 26-9(1972).

Translated from Radiokhimiya; 14: No. 1, 29-33(1972).

It was shown that the selectivity of various types of complexones for actinides and lanthanides can be calculated on the basis of the rule of additivity of the strengths of the individual rings. The nature of the bonds in chelate complexes of different type was discussed; it was shown that the coordination number of the rare earth and transplutonium elements in chelate complexes may reach 9–10. Data were obtained for Am, Cm, and Ce complexes. (auth)

50400 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XII. ADDITIVITY OF THE STRENGTH OF THE INDIVIDUAL RINGS. Shalinets, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 18-25(1972).

Translated from Radiokhimiya; 14: No. 1, 20-9(1972).

It was shown that for similar steric conditions the strength of a complex is the sum of the strengths of the individual rings $\lg \beta_n^0 = \sum_i n_i \cdot \epsilon_i$, and the strength of certain individual rings was calculated. Values of $\lg \beta_n^0/n_{max}$ for the stability constants of complexes of Am, Cm, and Ce are given. The influence of various factors on the strength of the rings, such as the basicity of the donor atoms, the presence of substituents in the ring, and the number and size of the rings, is discussed. (auth)

50401 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XIV. HYDROXYETHYLIMINO-N, N'-DIACETIC ACID. Shanlinets, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 30-3(1972).

Translated from Radiokhimiya; 14: No. 1, 33-7(1972).

The complex formation of Am, Cm, and Ce with hydroxyethylimino-N,N'-diacetic acid was investigated by the method of electromigration in a porous filler. Stability constants obtained by a graphical method were considered as tentative values and their more accurate values were determined by the method of successive approximations of the calculated values of the mobilities to the experimental values. Hydroxyethylimino-N,N'-diacetic acid seemed more promising than DTPA for group separation. (M.C.G.)

50402 SOLUBILITY OF THORIUM NITRATE PENTAHYDRATE IN ETHER–DILUENT MIXTURES. Vdovenko, V. M.; Statesvich, V. P.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 138-41(1972).

Translated from Radiokhimiya; 14: No. 1, 136-40(1972).

The solubility study was limited to regions of low and medium solubilities. Mixtures of ether and diluent were brought into equilibrium with an excess of salt, agitated for 7 to 8 hr, and after prolonged standing, the thorium content was determined by a gravimetric method. It was concluded that the solubility is higher in cases of those diluents for which increased activity in the intermolecular interaction with respect to the solvate can be imagined. (M.C.G.)

50403 QUESTION OF COLLOIDS AND RADIOCOLLOIDS. Davydov, Yu. P. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 142-4(1972).

Translated from Radiokhimiya; 14: No. 1, 140-2(1972).

Studies were made to determine if there is an interrelationship between the solubility product and the formation of colloids in the presence of microconcentrations of the element in solution. It was concluded that there was no predictable relationship. (M.C.G.)

50404 XENON HEXAFLUORIDE–URANIUM PENTAFLUORIDE COMPLEX XeF_6UF_5. Frlec, B. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia); Bohinc, M.; Charpin, P.; Drifford, M. J. Inorg. Nucl. Chem.; 34: No. 9, 2938-41(Sep 1972).

Since the magnetic and solution properties of the compound XeF_6UF_5 indicated an ionic structure, the Raman spectra of the solid and its solution were expected to be interpreted on this basis. However, in the observed spectra no bands were found which could be unambiguously attributed to the UF_6^- species. Comparisons of these spectra with some others of related compounds were made in an attempt to elucidate the nature of the XeF_6UF_5 adduct. In addition, thermal decomposition of the compound was investigated, in order to contribute to the knowledge of the reactions in the system xenon fluorides–uranium fluorides. (auth)

50405 STRUCTURE OF AQUEOUS THORIUM NITRATE SOLUTIONS BY LASER RAMAN SPECTROSCOPY. Oliver, B. G.; Davis, A. R. (Dept. of the Environment, Ottawa). J. Inorg. Nucl. Chem.; 34: No. 9, 2851-60(Sep 1971).

The laser Raman spectra of aqueous $Th(NO_3)_4$ solutions and the complementary ir spectra were determined at 25°C. Spectra indicate the presence of pronounced ion–ion and ion-solvent interactions in the system. The results can best be explained in terms of an equilibrium between "complexed" and "free" nitrate in the system. The stoichiometry of the complexes and the concentration quotients for the solution equilibria were determined by the molar ratio method. (auth)

50406 SULFATE COMPLEXES OF SOME TRIVALENT TRANSPLUTONIUM ACTINIDES AND EUROPIUM. McDowell, W. J.; Coleman, C. F. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2837-50(Sep 1972).

The sulfate complexes of Eu, Am, Cm, Bk, Cf and Es were investigated by a solvent extraction method using neutral species distribution between a benzene solution of a long-chain amine sulfate and aqueous sulfuric acid–sodium sulfate solutions. Sulfate was the only anion present and the ionic strength varied with the ligand concentration. Activity coefficient effects over the ligand concentration range examined (up to 0.5M) were estimated by a Debye–Hückel expression. The use of the Debye–Hückel equation is justified since the $\gamma \pm Na_2SO_4$ data can be fitted to 0.5M and even higher concentrations with the same equation. Evidence for important amounts of the heretofore unreported trisulfate species of these elements was found, but no evidence was found for tetrasulfate species. The equilibrium constants for all of the actinides are close together and show a smooth periodicity as Z varies. The equilibrium constants for europium are close to those for the actinides. Overall formation constants at zero ionic strength for the mono-, di- and trisulfates of each of the elements are given. Percent distribution of each actinide as a function of sulfate ion concentration is shown. (auth)

50407 ELECTRONIC ABSORPTION SPECTRUM OF GASEOUS URANIUM HEXACHLORIDE AND HEXAFLUORIDE. Hurst, H. J.; Wilson, P. W. (Australian Atomic Energy Research Establishment, Lucas Heights). Spectrosc. Lett.; 5: No. 8, 275-9(1972).

Studies were made to determine if any rotational fine structure was present in the uv absorption spectrum of UF_6 using conventional high-resolution spectrographs. The spectrum of UCl_6 was also studied. The spectrum of UF_6 showed weak absorption in the region 360 to 400 nm, and very much stronger absorption below 340 nm. The UCl_6 spectrum showed continuous absorption, similar to that for UF_6, but displaced to higher wavelength. No vibrational structure was observed. (M.C.G.)

50408 CHEMICAL STATE OF ^{99m}Tc IN BIOMEDICAL PRODUCTS. II. THE CHELATION OF REDUCED TECHNETIUM WITH DTPA. Eckelman, W. C.; Meinken, G.; Richards, P. (Brookhaven National Lab., Upton, N. Y.). J. Nucl. Med.; 13: No. 8, 577-81(Aug 1972).

An attempt was made to determine the precise oxidation state of ^{99m}Tc produced by various reducing agents. DTPA, [(carboxymethylimino)-bis(ethylenenitrilo)]tetraacetic acid, was used to chelate the reduced species, and chelation efficiencies were determined for various concentrations of ^{99m}Tc down to the carrier-free level. Data indicate that at the carrier level technetium is reduced to the IV state by stannous ions, $HCl-H_3PO_2$, ascorbic acid, and HCl–HI–KI. Concentrated HCl and a thiocyanate system produce the V state. It is concluded that the probable oxidation state of ^{99m}Tc in chelates used in biomedical products is the tetravalent state. This state can be made nonreactive by allowing hydrolysis of the species. (J.G.B.)

50409 BEHAVIOR OF URANYL SALTS IN AQUEOUS BINARY AND TERNARY SYSTEMS. Kalman, E. (Technische Univ., Dresden). Acta Chim. Acad. Sci. Hung.; 72: No. 4, 407-21(1972). (In German).

The concentration dependence of various properties of uranyl salt solutions in water and in 0.1M $HClO_4$ was investigated. The measured results showed a strong structure-related effect of the uranyl ion. Binding between the ligand in the solution and uranium in the uranyl group was studied. (tr-auth)

50410 RADIOCHEMICALS. VARIABILITY OF QUANTITY IN 50 μCi PACKAGES. Von Korff, R. W. (Maryland Psychiatric Research Center, Baltimore). Nature (London); 238: No. 5363, 347-8(11 Aug 1972).

Warning is given of errors occurring in the labeling of commercial radioactive biochemicals in regard to radioactive content and purity, and it is stated that vials sold to contain 50 μCi should be confirmed as to amount. Vials of 2-^{14}C serotonin binoxalate were found to contain approximately twice the stated amount, and errors were found with sodium pyruvate. Difficulties are also found with biogenic amines. In some cases vial contents are dispensed by the supplier as solutions, and in other cases by the weighing of solids. It is recommended that reasonable limits of variability for both mass and radioactivity be cited both on the label and in the suppliers' catalogue for radioisotopes sold commercially. (UK)

50411 PHASES OF SCHEELITE STRUCTURE IN THE NEPTUNIUM MOLYBDATE AND SODIUM OR LITHIUM MOLYBDATE SYSTEMS. Pages, Monique (Institut du Radium, Paris); Freundlich, W. J. Inorg. Nucl. Chem.; 34: No. 9, 2797-2801 (Sep 1972).

The establishment of solid–liquid equilibrium diagrams for the systems $Np(MoO_4)_2-Na_2MoO_4$ and $Np(MoO_4)_2-Li_2MoO_4$, coupled with solid-state studies by x-ray diffraction, led to the discovery of three new phases: $Na_2Np(MoO_4)_3$ with scheelite structure, and $Na_4Np(MoO_4)_4$ and $Li_4Np(MoO_4)_4$ with a scheelite superstructure. Congruent fusion occurs only with the lithium compound (m.p. = 647°C). No phase corresponding to Li_4NpMoO_4 is observed for thorium, whereas the sodium compounds of Np and Th are isostructural. (auth)

50412 TENSIMETRIC STUDY OF THE SYSTEM URANIUM TETRAFLUORIDE–ANHYDROUS HYDRAZINE. Glavic, P.; Bole, A. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). J. Inorg. Nucl. Chem.; 34: No. 9, 2959(Sep 1972).

It was reported that uranium tetrafluoride yields with anhydrous hydrazine addition compounds of the composition $UF_4 \cdot N_2H_4$ and $UF_4 \cdot 1.5N_2H_4$. During that work an indication was obtained that adducts with higher hydrazine content might exist. A tensimetric study was made, therefore, of the system uranium tetrafluoride–anhydrous hydrazine. The results confirm the existence of the compound $UF_4 \cdot 2N_2H_4$. (auth)

50413 REACTIONS OF XENON FLUORIDES WITH URANIUM FLUORIDES. Bohinc, M.; Frlec, B. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). J. Inorg. Nucl. Chem.; 34: No. 9, 2942-6(Sep 1972).

Uranium pentafluoride forms with xenon hexafluoride two compounds of the compositions $UF_5 \cdot 2XeF_6$ and $UF_5 \cdot XeF_6$. Since the same compounds can be prepared starting from uranium tetrafluoride, a study was made of the reactions between xenon fluorides and uranium fluorides in order to investigate the oxidation-reduction reactions in this system, which might yield some complexes in addition to those previously described. (auth)

50414 COMPLEX CHROMIUM AND URANYL ISOCYANATES. Bailey, R. A.; Michelsen, T. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Inorg. Nucl. Chem.; 34: No. 9, 2935-7(Sep 1972).

The ligand behavior of the cyanate ion is of interest because of its potential ambidentate character. Several systems, in which the metal ion shows a strong affinity for oxygen donors, were examined to see if 0-bound cyanates would be formed. A description is given of new cyanato complexes of Cr(III) and U(IV), both of which favor oxygen in other systems (the former is also a d^3 ion, analogous to Mo(III) and Re(IV) which are among the other possible 0-bonded compounds). Although these show no evidence of the oxygen bonding mode, they are interesting additions to the known cyanato complexes. (auth)

50415 COMPARATIVE STUDY OF THE ABSORPTION SPECTRA OF URANYL COMPLEXES IN SOLUTION AND IN THE SOLID STATE. THE SYMMETRY COMPLEXES: C_s, $D_{2h}(6)$, AND $D_{3h}(6)$. Goerller-Walrand, C.; de Jaegere, S. (Univ., Louvain, Belgium). J. Chim. Phys.; 69: No. 4, 726-36 (Apr 1972). (In French).

The absorption spectra of uranyl complexes with bidentate ligands (NO_3^-, $HCOO^-$, CH_3COO^-, $C_2O_4^{2-}$, CO_3^{2-}, SO_4^{2-}) were obtained both in solution and in the solid state. The essential similarity between the two spectra indicated that the spectral behavior of UO_2^{2+} between 20,000 and 30,000 cm^{-1} is determined by its immediate environment. More specifically, it is shown that the symmetry of the first equatorial coordination sphere of UO_2^{2+} determines the intensity and the number of electronic transitions in the spectrum. On the other hand, the vibrational structure depends on the chemical nature of the ligands. (France)

Radioactive Waste Treatment

Refer also to abstract 51164.

50416 (CONF-720827–1) PROCESS SELECTION FOR THE REMOVAL OF RADIONUCLIDES FROM LOW-LEVEL WASTES AT OAK RIDGE NATIONAL LABORATORY. Holmes, J. M.; Harrington, F. E. (Oak Ridge National Lab., Tenn.). 1972. 14p. Dep. NTIS.

From 73rd national meeting of the American Institute of Chemical Engineers; Minneapolis, MI. (27 Aug 1972).

Two processes, developed specifically for the decontamination of ORNL low-level wastes, were evaluated. The major radioactive contaminants that must be removed are ^{90}Sr and ^{137}Cs. Both processes contain precipitation and ion exchange steps; however, they differ with regard to the point at which the bulk hardness is removed from the water. Flowsheets are shown for the scavenging-precipitation ion-exchange process and the clarification ion-exchange process. Capital costs, operating costs, and comparison of processes are discussed. (M.C.G.)

50417 (STI/DOC–10/136) USE OF LOCAL MINERALS IN THE TREATMENT OF RADIOACTIVE WASTE. (International Atomic Energy Agency, Vienna (Austria)). Jun 1972. 113p. IAEA $4.00.

Applications of mineral resources in radioactive waste management are discussed, with emphasis placed on the use of local minerals in developing countries and areas where, due to the availability of inexpensive raw materials, nearness of burial site, or other economic or technical considerations, the use of local minerals can be economically feasible. Topics such as types of minerals, naturally occurring ion exchangers, possible applications, and classification and selection procedures are discussed. (M.C.G.)

50418 STUDY ON THE ELUTION OF RADIONUCLIDES FROM SOLIDIFIED WASTES. ON THE BEHAVIOUR OF RADIONUCLIDES IN CEMENT MILK. Terashima, Yutaka (Kanazawa Univ., Japan). Hoken Butsuri; 6: No. 3, 123-9 (Sep 1971). (In Japanese).

For the estimation of the leachability of several important radionuclides from wastes solidified in cement, their adsorptive behavior in cement milk was studied experimentally. Main results obtained are as follows: Cesium cannot be adsorbed at all on any crystalline cement hydrates in the cement milk. Some strontium was incorporated into the cement hydrates by mixing crystallization in the cement milk. In the solidified, therefore, a larger amount of it is assumed to be distributed in the stable crystal of cement hydrates. Zirconium, cobalt, zinc, and cerium were adsorbed firmly on the cement-hydrates, ruthenium and its nitro complex were less adsorbed, showing no significant difference in their behavior. These adsorptive characteristics were changed little by the presence of carriers and other salts. (auth)

50419 RADIOACTIVE WASTE MANAGEMENT IN WESTERN EUROPE. Paris; Agence Europeenne pour l'Energie Nucleaire ([1971]). 146p. (In French).

The sources of radioactive wastes are studied: mining and processing of U and Th ores, U enrichment and nuclear fuel fabrication, power reactors, irradiated fuel reprocessing. The preparation of sealed and unsealed radiation sources is described. Fundamental considerations are given concerning safety (ICRP recommendations, dose delivered to the population, environmental contamination, critical transfer paths, legislation and licensing), technology (processing of solid, liquid or gaseous effluents, waste transportation) and economics. The processing, storage and disposal of the various types of wastes are then described. Future problems concerning the management of long half-life α wastes, ^{85}Kr, and tritium are envisaged. (France)

50420 TREATMENT OF WASTES FROM CONVENTIONAL AND FROM NUCLEAR INDUSTRIAL PLANTS. Gromotka, H. Energ. Tech.; 24: No. 1, 4-8(1972). (In German).

Some examples that demonstrate the problems of waste treatment are discussed. As to conventional industrial plants, two points are emphasized: the mixing of gases in the combustion chamber and the danger of corrosion of the heating surfaces coupled at the outlet side. The concentration of liquid wastes from nuclear power plants in an evaporation plant is described. (INIS)

Radioisotope Production

Refer also to abstracts 50269, 51240, and 52241.

50421 (BNWL-B–6) RECOVERY AND PURIFICATION OF PLUTONIUM AND NEPTUNIUM FROM IRRADIATED NpO_2–Al AND NpO_2-GRAPHITE TARGETS. Wheelwright, E. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 4 Sep 1970. Contract AT(45-1)-1830. 22p. Dep. NTIS.

An ion exchange procedure for recovery and purification of plutonium and neptunium from neptunium target elements that were fabricated using aluminum or graphite matrix material and canned in aluminum or Zircaloy-2 is reported. Problems encountered which should be corrected before the facility is used on a production basis are discussed. (D.H.M.)

50422 (CNEA–315) PRODUCTION OF ^{203}Hg AT A LEVEL OF ACTIVITY OF THE ORDER OF A CURIE. Baez, M. C.;

Benetto, O. J.; Marques, R. O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 11p. (In Spanish). Dep. NTIS (U. S. Sales Only).

A procedure for the routine production of ^{203}Hg at high specific activity (in the form of chloride or acetate) from red mercury oxide is presented. The pile irradiation conditions of the sample and production equipment are fully described. The radioanalytical control methods used to check the purity of the final product are also included. The method, very simple as far as operations are concerned, gives a production yield of 95% and a radiochemical purity higher than 99%. (auth)

50423 (KFK–1453) NUCLIDE YIELD ON LENGTHY IRRADIATION OF PLUTONIUM IN BR2. Eberle, S. H.; Bleyl, H.-J.; Braun, H.; Baeckmann, A. v.; Koch, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Mar 1972. 25p. (In German). (EUR–4726-d). Dep. NTIS (U. S. Sales Only).

Nuclide yields from plutonium irradiation in the BR2 reactor were measured by radiochemical methods, mass spectrometry, and x-ray fluorescence. The initial heavy nuclides (91% ^{239}Pu, 8% ^{240}Pu, 1% $^{241/242}$Pu) were transformed almost 100% by neutron reactions, 91.2% into fission products and 8.8% into neutron capture products with mass numbers from 238 to 246. The main products are 48,700 ppM ^{242}Pu, 18,900 ppM ^{243}Am, 19,500 ppM ^{244}Cm, and 413 ppM ^{248}Cm. The irradiation resulted in formation of about twice the ^{244}Cm as would have been formed in the MTR and HFIR reactors at the same neutron dose. Evidently the Cm yield per neutron absorbed in these reactors is considerably lower than in the BR2. The yields were also calculated by considering the influence of neutron energy and the self-shielding in different ways and compared with the measurements. A conformity between measured and calculated yields within 1.3% was achieved by applying a formula for the dependence of the cross sections on the neutron energy, on the thermal self-shielding and on the resonance self-shielding. (auth)

50424 (UJV-2837-Ch) PREPARATION OF RADIOACTIVE ^{18}F BY IRRADIATION OF WATER WITH α PARTICLES. Hruby, J.; Mudrova, B.; Svoboda, K. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 41p. (In Czech). Dep. NTIS (U. S. Sales Only).

Experiments undertaken in order to obtain ^{18}F preparations in the cyclotron U-120 in Řež are described. The target material, distilled water, is irradiated in a special target chamber with the external beam of alpha particles (production reaction $^{16}O(\alpha,2n)^{18}F$) The target chamber consists of a basic aluminum target plate cooled with flowing water and an auxiliary device for recombination of gaseous radiolytic products. Irradiated water is placed in an oblong cavity separated by a thin titanium foil from the vacuum system of the cyclotron. About 2 mCi of ^{18}F can be prepared during 1 hour from irradiations of water with 25 MeV alpha particles (beam current of 30 μA). The amount of radioactive impurities in the product originating from the titanium foil (^{48}V,^{51}Cr) is highest after the first use of the foil reaching the value of 3 μCi. For subsequent irradiations it does not exceed 1 μCi. The ring-oven technique was used for the determining aluminum and titanium in the preparations. The concentration of titanium in all the samples analyzed was lower than the identification limit of the method used (concentration of $Ti < \sim 5.10^{-5}$ M), the concentration of aluminum varied from 1×10^{-3} to 1×10^{-4} M. The concentration of hydrogen peroxide, the presence of which was found in all preparations, is determined by manganometric titration and varies from 0.024 to 0.038%. The chemical form of ^{18}F in the preparations was also investigated. The main fraction of ^{18}F (~95%) is in the form of simple fluoride ions and only about 5% of ^{18}F is in the form of complex metal fluorides (probably AlF_6^{3-}). In addition the sorption of carrier-free ^{18}F on material used either for the construction of the target chamber or during the processing of irradiated water, i.e., on glass, polyethylene, aluminum and titanium was also studied. (auth)

50425 ^{113m}In-GENERATOR. Oniciu, L. Stud. Univ. Babes-Bolyai, Ser. Chem.; 17: No. 1, 5-22(1972). (In Rumanian).

A short literature survey on the ^{113m}In generator is presented. There is some information concerning various chemical compounds of In(III), which may be found in solutions eluted from the generator using HCl, and the preparation of the ^{113m}In generator column. Various preparations, which start from ^{113m}In(III) solution, and used in scintigraphy, are listed. The toxicity of In(III), chemical and radionuclidic purity control methods for ^{113m}In solutions, and some aspects of dose and protection problems are discussed. (auth)

50426 ISOTOPIC COMPOSITION OF ^{238}Pu FROM ^{241}Am AND REACTOR CROSS-SECTIONS OF ACTINIDE NUCLIDES. Ihle, H.; Michael, H.; Neubert, A.; (and others) (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 34: No. 8, 2427-37(Aug 1972).

^{242}Cm was prepared by irradiating ^{241}Am in the reactor BR2, Mol, Belgium. It was separated from other actinides and fission products by ion exchange. ^{238}Pu obtained by decay of ^{242}Cm is best suited for biomedical purposes since it is practically free from hazardous isotopic impurities like ^{236}Pu, for which an upper limit of 0.1 ppM was obtained. The concentrations of heavier plutonium isotopes were between 20 and 2000 ppM. Fractional concentrations of various nuclides were determined by mass spectrometry and by α counting. Effective reactor cross sections for the involved nuclides computed from these measurements are discussed. (auth)

50427 PRODUCTION OF ^{11}C WITH A 3-MeV VAN DE GRAAFF ACCELERATOR. More, R. D.; Troughton, J. H. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 344-5(Jul 1972).

Two methods are reported for the production of the short half-life (20.4-min) radioisotope ^{11}C for use for in vivo experiments. A 3-MeV Van de Graaff accelerator was used for the production of $^{11}CO_2$ from the reactions $^{12}C(^3He,^4He)^{11}C$ and $^{10}B(d,n)^{11}C$. The limitations of the former reaction and the advantages of the latter are given. By this latter method activities up to 80 μCi were recovered as carrier-free $^{11}CO_2$ gas from 2-cm-diameter by 2-mm-thick boric oxide targets irradiated for 30 min in a 4.0-μA beam of 2.5-MeV deuterons. (UK)

50428 COMMERCIAL RADIOISOTOPE PRODUCTION IN POWER REACTORS. Machurek, Joseph E.; Fowler, E. Eugene (Atomic Energy Commission, Washington, D. C.). Isotop. Radiat. Technol.; 9: No. 4, 375-8(1972).

The production of radioisotopes using power reactors is discussed from the viewpoint that power reactors will be the only source of particular radioisotopes in the quantities adequate to meet the market requirements. Four radioisotopes that merit consideration for possible future production in nuclear reactors are ^{238}Pu, ^{3}H, ^{14}C, and ^{60}Co. The production of the fission products ^{137}Cs, ^{90}Sr, and ^{147}Pm from power reactor operation are also considered. The selected isotopes are discussed in terms of best judgment as to estimated future requirements and power reactor production capacity. (D.H.M.)

50429 ISOLATION OF THE RADIOACTIVE ISOTOPE ^{133}Ba FROM CESIUM CHLORIDE IRRADIATED ON A CYCLOTRON. Erylchenko, V. P.; Lyakhov, A. V.; Sevast'yanov, Yu. G. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 160-1(1972).

Translated from Radiokhimiya; 14: No. 1, 154-5(1972).

Five grams of cesium chloride were dissolved in water and the isotopes ^{133}Ba, ^{83}Rb, ^{134}Cs, and ^{85}Sr were introduced into the solution. The solution was passed through an ion exchange resin, the resin washed, and γ spectrometric measurements made. A quantitative isolation of ^{133}Ba and its purification were achieved. (M.C.G.)

50430 PRODUCTION OF YTTRIUM-87 AND PREPARATION OF A GENERATOR OF STRONTIUM-87m. Levin, V. I.; Kurchatova, L. N.; Malinin, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 106-10(1972).

Translated from Radiokhimiya; 14: No. 1, 110-14(1972).

A method was developed for the isolation of ^{87}Y without a carrier from metallic strontium targets, irradiated with deuterons or protons, and from metallic rubidium, irradiated with α particles. The method ensures a yield of ^{87}Y no less than 99%. The extraction-chromatographic column with absorbed ^{87}Y was used as a generator of ^{87m}Sr without a carrier. In the case of elution with dilute hydrochloric acid, a preparation of ^{87m}Sr with a ^{87}Y impurity not exceeding 10^{-4}% was obtained, with a yield of 85 to 90% of the equilibrium amount. The chemical structure of ^{87m}Sr is present in this solution in the form of the Sr^{2+} ion, and its behavior does not differ from the behavior of inactive strontium, present in the ionic form. (auth)

50431 CHEMICAL ISOLATION OF KURCHATOVIUM. Zvara, I.; Belov, V. Z.; Domanov, V. P.; (and others). Sov. Radiochem. (Engl. Transl.); 14: No. 1, 115-18(1972).

Translated from Radiokhimiya; 14: No. 1, 119-22(1972).

A target of plutonium oxide (95% ^{242}Pu), 0.8 mg/cm^2 thick, was irradiated with ^{22}Ne ions with an energy of 119 MeV. A small portion of the area of the target was occupied by a layer of samarium oxide, so that the closest chemical homology of Element 104 would be obtained simultaneously. The recoil nuclei were retarded in a flow of nitrogen and chlorinating agents were introduced into the flow. Fission fragment tracks were obtained and evidence that they are associated with the decay of 4.5-sec ^{259}104 is presented. (M.C.G.)

50432 EXTRACTION OF TRIBUTYL PHOSPHATE FROM HYDROCHLORIC ACID SOLUTIONS. IV. SOLVATION OF ZINC AND COPPER BY THE EXTRACTION REAGENT. Abdukayumov, M.; Levin, V. I.; Kozlova, M. D. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 51-4(1972).

Translated from Radiokhimiya; 14: No. 1, 54-8(1972).

The extraction of zinc and copper (at low concentrations) by tributyl phosphate, diluted with heptane or hexane to different degrees, from 4 and 8 N hydrochloric acid, was investigated to seek optimum conditions for isolation of copper from a zinc target. It was established that the extraction of zinc and copper occurs in the form of complexes containing three molecules of tributyl phosphate. (auth)

50433 SEPARATION AND CONCENTRATION OF ZINC, GALLIUM, GERMANIUM, ARSENIC, AND SELENIUM BY COPRECIPITATION WITH FERRIC HYDROXIDE. Novikov, A. I.; Shchekoturova, E. K. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 157-9(1972).

Translated from Radiokhimiya; 14: No. 1, 152-4(1972).

The coprecipitation with ferric hydroxide of small quantities of Zn, Ga, Ge, As, and Se, present simultaneously, in solutions of 1M KNO_3 and 5M NH_4NO_3, was studied as a function of the pH of the medium. The conditions for concentration of small quantities of zinc, gallium, germanium, arsenic (V), and selenium(VI) by coprecipitation with ferric hydroxide and the conditions of their separation from the carrier after concentration were determined. A method is proposed for successive isolation of each component from a mixture of their compounds. Zinc, gallium, germanium, and arsenic were separated from selenium by coprecipitation with ferric hydroxide at pH = 7 to 9.5 in 1M KNO_3. Gallium, germanium, and arsenic were separated from zinc by coprecipitation with ferric hydroxide at pH = 8.3 to 9.4 in 5M NH_4NO_3. Gallium was separated from germanium and arsenic by reprecipitation of the carrier in concentrated ammonia at pH = 10.3, while arsenic was separated from germanium and the carrier by reprecipitation of the latter in 0.1M KOH. The separation of germanium from ferric hydroxide was achieved by precipitation of the carrier in 5M KOH. (auth)

50434 COMMERCIAL RADIOISOTOPE PRODUCTION IN NUCLEAR POWER REACTORS. Machurek, Joseph E.; Fowler, E. Eugene (Atomic Energy Commission, Washington, D. C.). Nucl. News; 15: No. 4, 53-6(Apr 1972).

Those areas of radioisotope production in which power reactors serve no useful role, isotopes well suited to production in power reactors, and isotopes that would serve important requirements of the public and national interest are considered. Four isotopes are discussed as meriting consideration for possible future production in nuclear power reactors. These are in addition to fission product isotopes and are ^{238}Pu, tritium, ^{14}C, and ^{60}Co. Market evaluation data are discussed. (M.C.G.)

50435 DIE BEDEUTUNG EINES KERNREAKTORS FUER DIE MEDIZINISCHE FORSCHUNG UND DIE KLINISCHE PRAXIS. (Significance of Nuclear Reactors for Medical Research and Clinical Practice). Lorenz, Walter J. Theoretische und Klinische Medizin in Einzeldarstellungen, Band 53. Heidelberg; Dr. Alfred Huethig Verlag (1970). 100p. DM 24,-.

The physical foundations of nuclear reactors and their application in biology and medicine are discussed. Specifically outlined are properties of the 250 kW TRIGA Mark-1 reactor at the Nuclear Medicine Institute of the German Cancer Research Center at Heidelberg. Short-lived isotopes, activation analysis, and dosimetry are discussed. Also outlined are radiochemical procedures that are needed for production of radionuclides and for activation analysis. (H.B.G.)

Reactor Fuel Reprocessing

Refer also to abstracts 50270, 50283, 50285, 50286, 50288, 50291, 50624, 51113, 52385, and 52550.

50436 (CONF-720521-1) NUCLEAR FUEL CYCLE. Brooksbank, R. E. (Oak Ridge National Lab., Tenn.). 1972. 38p. Dep. NTIS.

From State Radiological Health Personnel meeting; Oak Ridge, TN. (30 May 1972).

A brief description of the nuclear fuel cycle is presented with emphasis on health and safety. Areas included are: mining, enrichment, fuel reprocessing, shipping, waste disposal, and regulation control and methods within the cycle. (D.H.M.)

50437 (DOCKET-50201-130) WEST VALLEY REPROCESSING PLANT. Head End Ventilation System Performance Report, January 1, 1972–June 30, 1972. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 18 Aug 1972. 7p. Dep. NTIS.

The performance of the head-end ventilation system during the period 1/1/72 to 6/30/72 is summarized. A battery for the gas monitor was added. The changing of pre-filters and roughing filters is discussed. The absolute filters were not changed. (M.C.G.)

50438 (DOCKET-50268-34) MIDWEST FUEL RECOVERY PLANT. Final Safety Analysis Report, Amendment 27, Change. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 28 Aug 1972. 1p. Dep. NTIS.

A request is presented for a change in modification to allow operation of the steam boiler to allow 100 psig steam at point of use. (M.C.G.)

50439 (ORNL-4801, pp 51-86) AQUEOUS STUDIES. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.

AMMONIUM HYDROXIDES—dissociation in potassium chloride media to 300°C, pp. 54-5
CADMIUM NITRATES—transference numbers in highly concentrated aqueous melts of, pp. 61-2
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  —solubility in sodium perchlorate–sodium sulfate–water system from 0 to 350°C, pp. 58-9
  —solubility in brackish well waters, effects of polyphosphate additives, on, pp. 59-60
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  —separation from distillation plant blowdown brine, p. 81
COPPER ALLOYS AND SYSTEMS—Cu–Ni, dissolution in high temperature chloride solutions, anodic, pp. 75-6
  —corrosion in high temperature flowing salt water solution, pp. 76-7
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LIQUID METAL FAST BREEDER REACTOR—fuel reprocessing for, corrosion studies associated with, pp. 78-9
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  —distillation of, potential methods of cleaning heat transfer tubing in plant for
SODIUM—diffusion coefficients in polyacrylic acid–water mixtures, self-, pp. 62-4
STAINLESS STEEL—corrosion of austenitic, in LMFBR fuel reprocessing, pp. 78-9
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TANTALUM—corrosion in LMFBR fuel reprocessing, pp. 78-9
THORIUM OXIDES—immersion of sol-gel, in water, pp. 72-3
  —immersion at elevated temperatures, heat of, p. 70
THORIUM OXIDES ThO_2—sorptive properties for nitrogen and water, gravimetric studies of, p. 71
  —spectra of surface species on sol-gel, ir, p. 73
TITANIUM—corrosion in LMFBR fuel reprocessing, pp. 78-9
WATER—dissociation to 300°C, study by flowing EMF cell of, p.53
ZIRCALOY-2—corrosion in LMFBR fuel reprocessing, pp. 78-9
ZIRCONIUM OXIDES—spectra of surface species on ZrO_2 ir, p. 73
  —immersion in water, heat of, p. 68
  —sorptive properties for argon, nitrogen, and water, gravimetric studies of, pp. 69-70 (D.H.M.)

50440 (RL-SEP-1) 1A COLUMN SPECIFIC GRAVITY CONTROL ANALYSIS BY ANALOG COMPUTER. Watrous, R. A.; Benham, R. D. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Oct 1964. Contract AT(45-1)-1350. 21p. Dep. NTIS.

Declassified 21 Oct 1971.

Several control schemes, simulated on an analog computer, were investigated to determine the type of system most practical to control the specific gravity of the Redox 1A extraction column. A control system employing 20 min deadtime compensation circuit was selected. The range of optimum proportional and reset rate settings for 20 min of deadtime compensation was determined.

A minimum in settling time of the controlled variable after a step-change in setpoint was used as a performance criterion for determining the range of optimum controller settings. Applying a deadtime compensation circuit in a control loop should markedly improve the specific gravity control of the Redox 1A extraction column. Use of 20 min of deadtime compensation in the controller should allow acceptable control of the column. Proportional gains of from two to four with a reset rate of 0.005 repeats per minute were found optimum for minimum settling time of specific gravity after a step change in setpoint. The results of the simulation can be used as a guide in determining the best controller settings for the process. (auth)

50441 (RT/CHI-(72)7) SULFURIC ACID DISSOLUTION OF MAGNOX CANS OF NATURAL URANIUM FUEL ELEMENTS IN A SEMICONTINUOUS DISSOLVER. Beone, G.; Caropreso, G.; Galuppi, G.; Mazzoleni, G. P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 13 Apr 1972. 46p. (In Italian). Dep. NTIS (U. S. Sales Only).

The feasibility of a flowsheet for decanning Magnox canned fuels, using sulfuric acid, was experimentally tested. The decanning runs were realized in a semicontinuous pilot dissolver. (M.C.G.)

50442 (SRO-525-5) SYNERGISTIC SOLVENT EXTRACTION. Progress Report, July 1971–June 1972. Davis, M. W. Jr. (South Carolina Univ., Columbia. Coll. of Engineering). Jul 1972. Contract AT(39-1)-525. 9p. Dep. NTIS.

Actinide–lanthanide equilibrium distribution data were studied in the synergistic system kerosene–TTA–TBP–dilute HNO_3 at various concentrations of HTTA, TBP, and HNO_3. (M.C.G.)

50443 STUDY OF THE RATE OF EXTRACTION IN SYSTEMS WITH TRIBUTYL PHOSPHATE. III. EXTRACTION OF $UO_2(NO_3)_2$. Pushlenkov, M. F.; Shchepetil'nikov, N. N.; Kuznetsov, G. I.; Lyakin, V. V.; Danilenkova, L. Ya. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 39-43(1972).

Translated from Radiokhimiya; 14: No. 1, 43-7(1972).

The kinetics of extraction of uranyl nitrate in the system $UO_2(NO_3)_2$–HNO_3–TBP–mixture of saturated hydrocarbons was studied as a function of the concentration of the components, the rate of mixing, and the temperature with the aid of a laboratory extractor with fixed interfacial surface. It was established that the rate of extraction of uranyl nitrate depends to a substantial degree on the rate of mixing. The experimental activation energy lies in the range 5.6 to 8.0 kcal/mole. The strong dependence of the rate of extraction of uranium on the rate of mixing and the low value of the activation energy allows the conclusion that convective diffusion transport is the limiting step in the process of extraction under these conditions. The rate of approach to equilibrium in the extraction of uranium(IV), plutonium(IV), and plutonium(VI) is close to the rate of extraction of uranium(VI), with all other conditions equal. This confirms the conclusion drawn on a diffusion nature of the processes studied. In the case of joint extraction of macroquantities of uranium(VI) and microquantities of plutonium(IV), the latter precedes uranium, but then there is a reextraction of plutonium into the aqueous phase as the extraction reagent becomes saturated with uranium. (auth)

50444 MODEL EXPERIMENTS ON CHEMICAL REPROCESSING OF NUCLEAR FUELS BY A CHLORIDE VOLATILIZATION PROCESS. PART 4. BEHAVIOR OF THE FISSION PRODUCTS MOLYBDENUM, NIOBIUM, ZIRCONIUM DURING VOLATILIZATION OF LOW URANIUM CHLORIDES BY CHLORINATION. Edelmann, B. U.; Reinhard, G.; Stahlberg, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 15: No. 2, 60-2(Feb 1972). (In German).

Experiments concerning the volatilization of uranium and the fission products molybdenum, niobium, and zirconium by chlorination in the temperature range from 250 up to 550°C are described. The reactions were performed using two different model mixtures. On the one hand, a mixture of low uranium chlorides with metallic molybdenum, niobium, and zirconium was used, on the other hand the nonvolatile fission products (alkaline earth and rare earth elements) in form of the chlorides of adequate concentrations were added. Depletions of uranium and the fission products molybdenum, niobium, and zirconium in the model mixtures were more favorable in presence of the nonvolatile fission products than in their absence; they amounted to about 10^2. The results of studies concerning the chlorination reprocessing on model mixtures obtained so far are compared. (auth)

50445 MODEL EXPERIMENTS ON CHEMICAL REPROCESSING OF NUCLEAR FUELS BY A CHLORIDE VOLATILIZATION PROCESS. PART 3. BEHAVIOUR OF TELLURIUM AND OF SOME ALKALINE, ALKALINE-EARTH, AND RARE-EARTH METALS OCCURRING AS TYPICAL FISSION PRODUCTS DURING VOLATILIZATION OF LOW URANIUM CHLORIDES BY CHLORINATION. Reinhard, G.; Stahlberg, R.; Edelmann, B. U. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 15: No. 1, 23-6(Jan 1972). (In German).

An essential increase of volatilization of tellurium chlorides was observed during chlorination of model mixtures with increasing reaction time and temperature. The results were improved by UCl_4 present in the initial mixture. However, decontamination of uranium from tellurium is insufficient within the range of temperatures near 450°C. On the other hand, first treating the model mixtures with chlorine at 200 to 300°C for some time resulted in an essentially higher trend of $TeCl_4$ to volatilize than of the uranium chlorides, and preliminary depletion of tellurium from uranium was obtained. Decontamination from tellurium of the uranium volatilized by chlorination at 450°C after this was high and may be improved by sublimation programmed in temperature. Entrainment of both CsCl and of the compounds $LaCl_3$, $CeCl_3$, and $NdCl_3$ at 450°C was about $5^{0}/_{00}$ after reaction times of 5h. For $SrCl_2$ and $BaCl_2$ no volatilization was found under the conditions applied. The presence of UCl_4 did not positively affect volatilization of alkaline, alkaline earth, and rare earth metals, although low-melting eutectics might give rise for this. No interfering molten phases were found. (auth)

50446 CRITICALITY OF PLUTONIUM NITRATE SOLUTION CONTAINING SOLUBLE GADOLINIUM. Llyod, R. C.; Clayton, E. D.; Hansen, L. E. (Battelle-Northwest Lab., Richland, Wash.). Nucl. Sci. Eng.; 48: No. 3, 300-4(Jul 1972).

Experiments were performed to establish the effect of a soluble neutron absorber (gadolinium nitrate) on the criticality of plutonium nitrate solutions. The solutions contained plutonium at concentrations of ~116 g Pu/liter and at ~363 g Pu/liter. Measured quantities of gadolinium nitrate were mixed with these solutions to produce changes in critical solution height within a 24-in.-dia water-reflected cylinder. Gadolinium concentrations up to 20.25 g Gd/liter were used and the effect determined through the observed change in height. Monte Carlo calculations were used to compute the criticality factors (k_{eff}'s) for each of the measured critical configurations. The computed factors were below unity in each case (largest departure about 2% less than unity). The gadolinium proved to be an effective neutron absorber. Its effectiveness decreased significantly, however, in the higher plutonium concentration and faster neutron spectrum. Although comparable values of k_∞ were computed (1.603 and 1.503) for the two plutonium concentrations in the experiments, the calculations showed 2.4 g Gd/liter would be required to reduce k_∞ to unity in the first case, whereas about 72 g Gd/liter would have been required in the second (316 g Pu/liter solution). Curves were prepared showing the computed quantities of gadolinium required to reduce k_∞ to unity as a function of plutonium concentration. Also included are computed critical radii for infinitely long cylinders of plutonium nitrate solution for several different gadolinium concentrations. There was no evidence of chemical instability (or precipitation) of the gadolinium in the plutonium nitrate solution during the course of the experiments and over a 1-mo long test (a question of concern in using soluble poison for criticality control). (auth)

50447 DISTRIBUTION OF LANTHANIDE AND ACTINIDE ELEMENTS BETWEEN MOLTEN LITHIUM HALIDE SALTS AND LIQUID BISMUTH SOLUTIONS. Ferris, L. M.; Smith, F. J.; Mailen, J. C.; Bell, M. J. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2921-33(Sep 1972).

Measurements of the equilibrium distribution of several lanthanide and actinide elements between liquid bismuth solutions and a variety of lithium halide salts were made in the temperature range 600 to 750°C. The salts included molten LiCl, LiBr, and several $LiF-BeF_2-ThF_4$ solutions. At each temperature, the distribution coefficients (mole fraction in the bismuth phase divided by mole fraction in the salt phase) for most of the solutes obeyed the relationship $D_M = (N_{Li}^n)(K_M^*)$, in which n is the oxidation number of solute M^{n+} in the salt phase and N_{Li} is the mole fraction of lithium in the bismuth phase. Under the experimental conditions employed (N_{Li} ranging between 10^{-5} and 0.3), thorium and protactinium were in the 4+ oxidation state in the salt phase; La, Nd, U, Np, Pu, and Cm were tripositive; and Ba and Eu were dipositive. The values of log K_M^* generally decreased regularly with increasing temperature. The oxidation numbers of Sm, Am, and Cf in the salt phase varied between 3+ and 2+, depending on the experimental conditions. Californium existed primarily in the 2+ oxidation state with LiCl as the salt phase, whereas, in fluoride salts, the californium was tripositive. The variation of the distribution coefficients of Sm, Cf, and Am with N_{Li} at a given temperature could be expressed as $D_M = N_{Li}^3/(\alpha + \beta N_{Li})$, in which α and β are constants. (auth)

50448 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. XVI. EFFECT OF TRI-n-BUTYL PHOSPHATE ON THE

EXTRACTION OF SOME METALS BY DI-(2-ETHYLHEXYL) PHOSPHORIC ACID IN n-HEXANE. Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 34: No. 9, 2911-20(Sep 1972).

Tri-n-butyl phosphate (TBP) causes only an antagonistic effect on the extraction of Eu(III), Am(III), Zr(IV), and Nb(V) by di(2-ethylhexyl) phosphoric acid (HDEHP) in n-hexane from aqueous solutions containing perchlorate, citrate, and nitrilotriacetate at log $H^+ = -2.87$ and in extracting Eu(III) from a perchlorate solution at log $H^+ = -0.70$. A weak synergic effect occurs in the extraction of Sr(II) from solutions containing perchlorate and citrate at log $H^+ = -2.87$. The complexes $EuA_3 \cdot HA \cdot yB$ (with A, HA and B denoting the anion of HDEHP, the molecule of HDEHP and the molecule of TBP respectively), $EuA_3 \cdot yB$ and possibly also $EuA_2(ClO_4) \cdot yB$ are extracted from 0.2M $HClO_4$ + 0.8M $NaClO_4$. With 0.10M citric acid + 0.15M monosodium citrate + 0.85M $NaClO_4$ as the aqueous phase, the complexes $EuA_3 \cdot 3HA$, $AmA_3 \cdot 3HA$, $SrA_2 \cdot 2HA \cdot B$ and $SrA_2 \cdot 2HA \cdot 2B$ prevail in the organic phase at the TBP concentration 0.08 to 0.1F, while the complexes $EuA_3 \cdot HA \cdot yB$, $AmA_3 \cdot HA \cdot yB$, $SrA_2 \cdot yB$, $SrA_2 \cdot HA \cdot yB$ and probably also $SrA_2 \cdot 2HA \cdot yB$ are formed at 1.0F TBP. The value of y in the above complexes could not be determined. (auth)

50449 PROCESS FOR CONTROL OF DISSOLUTION. Dedaldechamp, Paul; Le Bouhellec, Joel (to Commissariat a l'Energie Atomique). French Patent 2,092,864. 28 Jan 1972. Filed 25 Jun 1970. (In French).

A process is described for the dissolution of irradiated nuclear fuels characterized by the fact that it consists of removing continuously a portion of the gas that is formed in the course of the dissolution of the irradiated nuclear fuels, following the evolution of the radioactive gas, especially ^{85}Kr, in the gases removed by the passage of the above-mentioned gases into an ionization chamber, and following the dissolution until no radioactive gas can be detected. (tr-auth)

50450 IMPROVEMENTS IN OR RELATING TO THE TREATMENT OF IRRADIATED NUCLEAR FUEL ELEMENTS. Strong, Robert Edmund (to United Kingdom Atomic Energy Authority). British Patent 1,274,357. 17 May 1972. Filed 3 Feb 1970.

Reference is made to the processing of metal-sheathed ceramic fuel elements. Present practice is to shear such fuel elements into short lengths mechanically and to dissolve out the fuel material for processing. The process described involves rupturing the sheath by subjecting the fuel element to local induction heating, and shearing into short lengths is unnecessary. Rupture occurs when a portion of a fuel element placed lengthwise within an induction coil is exposed to an rf magnetic field which heats the sheath to its melting temperature. A crack is first generated as a result of local melting and is extended by relative axial movement of the element and coil. The process has been applied to stainless-steel sheaths enclosing oxide fuel. A frequency of 0.1 to 1.0 MHz is suitable, and heating is preferably confined to short lengths of sheath (~5 cm) by the use of current concentrators. A feed rate of ~2.5 cm/sec through the coil produced satisfactory results, and it is possible to rupture fuel elements arranged in clusters in this way. (UK)

50451 SOLVENT EXTRACTION OF CESIUM AND RUBIDIUM TRIPHENYLCYANOBORON. Lee, D. A. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2895-2901(Sep 1972).

Sodium triphenylcyanoboron was studied for the solvent extraction of cesium and rubidium ions from aqueous salt solutions. A comparison was made with sodium tetraphenylboron, and the nature of the extracted species was deduced by the method of equilibrium shift. The effect of the following parameters on the distribution coefficient was studied: metal ion concentration, equilibrium pH of the aqueous phase, reagent concentration and o-nitrotoluene concentration. Stripping of the metal ions from the organic phase was accomplished with ammonium nitrate solutions. (auth)

50452 FRACTIONATION OF NUCLEAR FUEL PARTICLES. Krupp, F. (to Fried Krupp GmbH). German Patent 1,489,706. 19 Jun 1969. Filed 9 Oct 1965. (In German).

In a carrier medium, pressure waves fractionate nuclear fuel particles that consist of a core containing fissionable material and a graphitic envelope. The pressure waves are generated either by an ultrasound source, explosions affecting the carrier medium, or by electrical discharges between electrodes. The carrier medium represents a solvent for subsequent reprocessing of fissionable material and is inert with respect to fissionable material. (H.B.G.)

ENGINEERING

Energy Conversion

Refer also to abstracts 50502, 50503, 50616, 50754, 51052, 51565, 52415, and 52572.

50453 (AEC-tr-7138, pp 190-2) THERMOELECTRIC POWER SOURCE WITH A RANGE OF OUTPUT VOLTAGES. Geronin, E. E.; Kremnev, V. A.; Nelidov, V. V. Translated from Radiats. Tekh.; No. 3, (1969).

Since the use of voltage converters with thermoelectric generators to achieve a range of voltage outputs reduces the total efficiency, reliability, and operating life of such an electric power system, it is desirable to eliminate the voltage converter and to use thermoelectric batteries with a range of output voltages. Thermoelectric generators which produce several output voltages can be assembled from several separate thermoelectric blocks each of which supplies power to its own consumer, but such an arrangement requires an excessive number of thermoelectric blocks—one for each required output voltage. A method is described for connecting two thermoelectric blocks in an electric circuit to form a thermoelectric battery which can be used for the direct, simultaneous supply of power to several consumers requiring different voltages. A thermoelectric battery assembled by this method is cheaper, more compact and reliable, and has lower operating costs than a thermoelectric battery with blocks supplying power to their own consumers. (L.C.L.)

50454 (AEC-tr-7138, pp 193-5) RADIOISOTOPE-FUELLED THERMOELECTRIC POWER SOURCES OF THE "BETA" TYPE. Fradkin, G. M.; Kodyukov, V. M.; Ragozinskii, A. I.; Kazakov, E. A. Translated from Radiats. Tekh.; No. 3, (1969).

The development of ^{90}Sr-fueled "beta"-type thermoelectric power sources for automatic radiometeorological stations at remote sites is reviewed. (L.C.L.)

50455 (AEC-tr-7138, pp 217-22) PROCEDURAL PRINCIPLES OF THE CALCULATION OF TECHNICAL AND ECONOMIC PARAMETERS OF ISOTOPIC GENERATORS OF ELECTRIC POWER. Kodyukov, V. M.; Fradkin, G. M.; Smirnova, Z. M.; Konyukhova, D. V.; Purtova, M. I. Translated from Radiats. Tekh.; No. 3, (1969).

A method is described for predicting the economic feasibility of using radioisotope-fueled thermoelectric generators as electric power sources at remote sites. (L.C.L.)

50456 (MMM-3321-7) SNAP 21-B PROGRAM: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. **Quarterly Report No. 2, July 1, 1964–September 30, 1964. Antolak, T. J. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Oct 1964. Contract AT(30-1)-3321. 147p. Dep. NTIS.**

Declassified 18 Oct 1971.

This deep sea power supply system will utilize thermoelectric semiconductor PbTe alloys in the segmented form. When operated between 1100°F and 100°F these materials will perform at a 10% materials efficiency. A high temperature vacuum thermal insulation system will be incorporated into this power supply system to reduce overall heat losses and thus increase system efficiency. A new high strength titanium alloy —721 is being used for the power supply system pressure vessel. This material has a high strength to weight ratio, high compressive yield strength (110,000 psi), and has excellent resistive properties to salt water corrosion. The isotopic heat source, SR-90 titanate, to be used in this power system will be directly shielded with a depleted uranium (plus 8% molybdenum) alloy. The DC—DC converter incorporated into this system will operate at 90% efficiency. (auth)

50457 (MMM-3321-11) SNAP 21-B PROGRAM: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. **Quarterly Report No. 3, October 1, 1964–December 31, 1964. Antolak, T. J. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Jan 1964. Contract AT(30-1)-3321. 105p. Dep. NTIS.**

Declassified 18 Oct 1971.

The deep-sea power supply system will use segmented semiconductor PbTe thermoelectric alloys which, when operated between 1100°F and 100°F, will perform at 10% materials efficiency. Generator design modifications have resulted in attainment of thermoelectric performance at 94% of theoretical prediction. A high temperature vacuum thermal insulation envelope is being developed for this system. Alternate insulation designs are being investigated to ensure minimum heat loss with resultant increase in system efficiency. To prevent potential formation of high temperature eutectic solutions, a chromium-plated copper liner has been selected to separate the fuel capsule and the biological shield. This same method has been selected for the exterior of the shield in order to provide oxidation and eutectic protection. (auth)

50458 (MMM-3321-13) SNAP 21-B PROGRAM: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. **Bimonthly Report, January 1, 1965–February 28, 1965. Benson, D. A. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Mar 1965. Contract AT(30-1)-3321. 88p. Dep. NTIS.**

Declassified 18 Oct 1971.

The deep-sea power supply system will use segmented semiconductor PbTe thermoelectric alloys which, when operated between 1100 and 103°F will perform at 10% materials efficiency. Generator design modifications have resulted in attainment of thermoelectric performance at 94% of the theoretical prediction. A fuel capsule and radiation shield were developed that not only provide adequate fuel containment but have been proven to be completely safe in all environmental hazards and credible accidents. The high-temperature thermal insulation envelope was redesigned to provide additional strength and improve structural characteristics. (auth)

50459 (MND-2050-F-2(Vol.2)) STUDY FOR 250-WATT CONTROLLED REENTRY ORBITING NUCLEAR SYSTEM. VOLUME II. TECHNICAL. (Martin Co., Baltimore, Md.). 2 Nov 1966. Contract AT(29-2)-2050. 394p. Dep. NTIS.

Declassified 2 Nov 1971.

50460 (MND-2050-F-2(Vol.2)(App.)) STUDY FOR 250-WATT CONTROLLED REENTRY ORBITING NUCLEAR SYSTEM. VOLUME II. APPENDICES. (Martin Co., Baltimore, Md.). 2 Nov 1966. Contract AT(29-2)-2050. 477p. Dep. NTIS.

Declassified 2 Nov 1971.

50461 (MND-2062-3314-3(Vol.3)(App.A)) RE-ENTRY TEMPERATURE ERROR ANALYSES. (Martin Co., Baltimore, Md.). 1967. 67p. Dep. NTIS.

Declassified 2 Nov 1971.

50462 (MND-3060-15) FUELING FIXTURE AND GENERATOR INSTRUCTIONS. Technical Manual for SNAP 13. (Martin-Marietta Corp., Baltimore, Md.). 30 Jun 1964. Contract AT(30-1)-3060. 184p. Dep. NTIS.

Declassified 2 Nov 1971.

50463 (MND-3060-33) SNAP 13: THERMIONIC DEVELOPMENT PROGRAM GENERATOR FUELING REPORT. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Aug 1967. Contract AT(30-1)-3060. 74p. Dep. NTIS.

Declassified 2 Nov 1971.

50464 (MND-3283-2) RFD-2 FLIGHT TEST PROGRAM. **Final Summary Report. Burgio, R.; Clark, L.; Katz, H.; Petroff, C.; Scheider, M. G. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Jun 1965. Contract AT(30-1)-3283. 188p. Dep. NTIS.**

Declassified 2 Nov 1971.

50465 (MND-3296-2) FEASIBILITY OF ISOTOPIC POWER FOR MANNED LUNAR MISSIONS. VOLUME 2. MISSION, FUEL, AND NUCLEAR SAFETY AND RADIATION. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). May 1964. Contract AT(30-1)-3296. 75p. Dep. NTIS.

Declassified 2 Nov 1971.

50466 (MND-3307-33-1(Pt.1)) SNAP 17A SYSTEM, PHASE I FINAL SUMMARY REPORT. PART 1. **Streb, A. J. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Aug 1964. Contract AT(30-1)-3307. 397p. Dep. NTIS.**

Declassified 2 Nov 1971.

50467 (MND-3307-33-1(Pt.2)) SNAP 17A SYSTEM SAFETY, PHASE I FINAL SUMMARY REPORT. PART 2. Streb, A. J.; Harmisson, L. T. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Aug 1964. Contract AT(30-1)-3307. 309p. Dep. NTIS.

Declassified 2 Nov 1971.

50468 (MND-3393) ADVANCED ^{90}Sr SPACE POWER SUPPLY STUDY. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). **Aug 1964. Contract AT(30-1)-3393. 346p. Dep. NTIS. Declassified 2 Nov 1971.**

50469 (MND-3483) PRELIMINARY PARAMETRIC EVALUATION OF A KILOWATT THERMOELECTRIC ^{238}Pu POWER SYSTEM FOR LUNAR SURFACE OPERATION. **(Martin Marietta Corp., Baltimore, Md. Nuclear Div.). 15 Mar 1965. Contract AT(30-1)-3483. 110p. Dep. NTIS.**

Declassified 2 Nov 1971.

50470 (MND–3607-173-1(App.C)) SNAP 19 RADIATION MEASUREMENTS REPORT. Rosenthal, H. B.; Owings, W. D.; Hrubovcak, J. M. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Nov 1967. Contract AT(30-1)-3607. 8p. Dep. NTIS.
Declassified 2 Nov 1971.

50471 (MND–3612-7-2) POLONIUM RADIOISOTOPE THERMOELECTRIC GENERATOR. PHASE I TECHNICAL CONCLUSIONS. PART II. (Martin-Marietta Corp., Baltimore, Md.). Dec 1965. Contract AT(30-1)-3612. 33p. Dep. NTIS.
Declassified 2 Nov 1971.

50472 (MND–3612-8-1) POLONIUM RADIOISOTOPE THERMOELECTRIC GENERATOR. PART I. DEVELOPMENT PROGRAM. (Martin-Marietta Corp., Baltimore, Md.). Dec 1965. Contract AT(30-1)-3612. 310p. Dep. NTIS.
Declassified 2 Nov 1971.

50473 (MND–3612-8-2) POLONIUM RADIOISOTOPE THERMOELECTRIC GENERATOR. PART II. MANAGEMENT PROGRAM. (Martin-Marietta Corp., Baltimore, Md.). Dec 1965. Contract AT(30-1)-3612. 381p. Dep. NTIS.
Declassified 2 Nov 1971.

50474 (MND–3612-24) MODIFIED POLONIUM SPACE RTG PARAMETRIC STUDY. (Martin Marietta Corp., Baltimore, Md.). Jan 1966. Contract AT(30-1)-3612. 193p. Dep. NTIS.
Declassified 2 Nov 1971.

50475 (MND–10069) PERFORMANCE SPECIFICATION FOR A 500 WATT THERMIONIC POWER GENERATION SYSTEM. (Martin Co., Baltimore, Md. Nuclear Div.). 13 Dec 1962. Contract AT(30-1)-3021. 25p. Dep. NTIS.
Declassified 2 Nov 1971.

50476 (MND-P–2561) TASK 9 GENERATOR SYSTEM. FIELD OPERATING MANUAL. (Martin Co., Baltimore, Md.). 1 May 1961. Contract AT(30-3)-217. 29p. Dep. NTIS.
Declassified 2 Nov 1971.

50477 (MND-P–2686) SNAP PROGRAMS: UPPER ATMOSPHERE EXPERIMENTAL RE-ENTRY STUDY. PREFLIGHT ANALYSES. Hagis, William (Martin Co., Baltimore, Md. Nuclear Div.). Mar 1962. Contract AT(30-3)-217. 124p. Dep. NTIS.
Declassified 2 Nov 1971.

50478 (MND-P–2686(Amend.1)) SNAP PROGRAM: UPPER ATMOSPHERE EXPERIMENTAL RE-ENTRY STUDY. AMENDMENT I. POSTFLIGHT ANALYSIS OF EXPERIMENTAL DATA. Jedlicka, C.; Dallam, W. (Martin Co., Baltimore, Md. Nuclear Div.). Jun 1962. Contract AT(30-3)-217. 44p. Dep. NTIS.
Declassified 2 Nov 1971.

50479 (MND-P–2804) SAFETY TEST REPORT FOR THE SNAP 9A THERMOELECTRIC GENERATOR TRANSIT MISSION. Dobry, T. J. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Jul 1962. Contract AT(30-1)-2871. 178p. Dep. NTIS.
Declassified 2 Nov 1971.

50480 (MND-P-2833) SNAP PROGRAMS: UPPER ATMOSPHERE EXPERIMENTAL RE-ENTRY STUDY. Summary Report. Dallam, W.; Jedlicka, C.; Hagis, W. (Martin Co., Baltimore, Md. Nuclear Div.). Jul 1962. Contract AT(30-3)-217. 58p. Dep. NTIS.
Declassified 4 Nov 1971.

50481 (MND-P–2950-1) OPERATIONAL TRANSIT SYSTEM, SNAP 9A. Martin Radioisotope SNAP Technical Brief No. 1. (Martin Co., Baltimore, Md.). 28 Feb 1963. Contract AT(30-1)-2871. 21p. Dep. NTIS.
Declassified 2 Nov 1971.

50482 (MND-P–3098-2) SNAP 9A ^{238}Pu FUELED THERMOELECTRIC POWER SUPPLY FOR AUXILIARY SPACE POWER. VOLUME II. Final Report. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). [nd]. Contract AT(30-1)-2871. 225p. Dep. NTIS.
Declassified 2 Nov 1971.

50483 TERMODINAMIKA ZHIDKOMETALLICHESKIKH MGD-PREOBRAZOVATELEI. (Thermodynamics of Liquid Metal MHD-Converters). Kalafati, D. D.; Kozlov, V. B. Moscow; Atomizdat (1972). 192p.

The thermodynamics of the MHD conversion of thermal energy into electrical energy through the medium of liquid metals as the working substance are examined. The future use of liquid metal MHD converters both in stationary and mobile form is considered in connection with nuclear heat sources. Possible thermodynamic cycles and the extent of their applicability are discussed in their relation to liquid metal MHD converters and to methods for increasing their efficiency. (93 references) (tr-auth)

50484 OUR ENERGY SUPPLY AND ITS FUTURE. Battelle Res. Outlook; 4: No. 1, 1-41(1972).

Predictions are made concerning the production, transmission, and consumption of energy during the period from 1975 to 2000 A.D. The subjects discussed include: getting energy to the user; methods for reducing energy consumption; advancements in energy storage; unconventional energy sources; and the development of power reactors. (L.C.L.)

50485 NUCLEAR POWER SOURCE. Round, Kenneth J. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,678,303. 18 Jul 1972. Filed 28 Jan 1970.

A means is provided for utilizing radioactive emission from a radioisotope to generate relatively high voltages at small current densities. (Official Gazette)

50486 LET'S FACE IT: THERE'S A FUEL CRISIS. Smock, Robert W. Elec. Light Power (Boston); 50: No. 13, 27-36(Jul 1972).

The fossil fuel crisis is discussed in terms of the requirements of electric utilities in the U.S. between 1970 and 1990. The short-term cost crisis as illustrated by the rapid rise in fuel costs between 1970 and 1972, the depletion of known U.S. natural gas reserves, the adverse environmental effects of mining coal and burning it in conventional power plants, the decrease in domestic petroleum reserves and the problems involved with relying on foreign oil imports, and the development of refuse-burning power plants are reviewed. Since the U.S. cannot continue to use gas and oil reserves faster than new reserves are discovered and since fast breeder power plants will not significantly affect power production until the 1990's, it is concluded that there is an urgent need to develop new technology for using coal, the most plentiful source of fossil fuel, to produce electric power. The development of coal-gas-fueled MHD power plants is suggested. (L.C.L.)

50487 UTILITIES WARM UP TO HOT WATER POWER PLANTS. Elec. Light Power (Boston); 50: No. 13, 37-8(Jul 1972).

A new way to use geothermal energy, making use of hot water rather than steam, is discussed. A look at the potential of this new energy source and a brief description of the first plant are given. (auth)

50488 PUBLIC ACCEPTANCE: A JAPANESE VIEW. Ipponmatsu, Tamaki (Japan Atomic Power Co., Tokyo). Int. At. Energy Agency Bull.; 14: No. 2, 12-18(1972).

A review of nuclear power development in Japan is presented along with discussions of public acceptance and environmental effects. (J.R.D.)

50489 DIRECT CONVERSION OF CHARGED PARTICLE ENERGY BY MEANS OF ELECTROSTATIC SYSTEM. Vinogradova, O. A.; Dimitrov, S. K.; Zhitlukhin, A. M.; (and others). At. Energ. (USSR); 33: No. 1, 586-9(Jul 1972). (In Russian).

A system of tapered diaphragms with a constant decelerating field is proposed for the direct conversion of the energy of charged particles, and the trajectory of ions during the in passage through the system was studied. The efficiency of conversion by the diaphragm system was measured as a function of ion energy, with the conclusion that any ion with a definite given energy reaches "its" diaphragm, thus assuring a high conversion efficiency (96%). The absence of charged particles was experimentally demonstrated. (K.S.W.)

Facilities and Equipment

Refer also to abstract 50583.

50490 (CISE-R–240) REBO FACILITY FOR IRRADIATION EXPERIMENTS ON CIRENE FUEL ELEMENT. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1967. 29p. (In Italian). INIS.
Declassified 1971.

A facility to test the behavior of fuel pins irradiated in conditions similar to those existing in the CIRENE reactor is described. Information that can be gained includes results of studies on behavior of Zircaloy-2 and of welds during heat transfer and analysis of the behavior of UO_2 pellets under conditions such as thermal cycling, and loss of coolant. (INIS)

50491 (CONF-700926–(Vol.1)) PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM ON FRESH WATER FROM THE SEA, DUBROVNIK, 13–17 SEPTEMBER 1970. VOLUME 1. PROPERTIES OF SEA WATER AND ELECTROLYTES DISTILLATION PROCESSES. Delyannis, A.; Delyannis, E. (eds.) (European Federation of Chemical Engineering. Working Party on Fresh Water From the Sea). 725p. (In several languages).

Fifty-one of the papers presented at the 3rd International Symposium on Fresh Water from the Sea are included in Volume 1. The areas covered include properties of seawater and electrolytes, distillation processes, heat transfer, corrosion, and solar evaporation. (D.H.M.)

50492 (CONF-700926-(Vol.2)) PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM ON FRESH WATER FROM THE SEA, DUBROVNIK, 13-17 SEPTEMBER 1970. VOLUME 2. IONIC PROCESSES. Delyannis, A.; Delyannis, E. (eds.) (European Federation of Chemical Engineering. Working Party on Fresh Water From the Sea). 628p. (In several languages).

Forty-two of the papers presented at the 3rd International Symposium on Fresh Water from the Sea are included in Volume 2. The areas covered include ion exchange, ion exchange membranes, and electrodialysis (osmosis, piezodialysis, and reverse osmosis). (D.H.M.)

50493 (MLM-1917) AUTOMATED DEVICE FOR DISPENSING PRECISE AMOUNTS OF POWDER. Osborne, J. M.; McGraw, H. R.; Draut, C. F. (Mound Lab., Miamisburg, Ohio). [nd]. Contract AT-33-1-Gen-53. 21p. (CONF-720910-1). Dep. NTIS.

From second symposium on storage and flow of solids; Chicago, IL. (17 Sep 1972).

A device for automated dispensing of precise amounts of finely divided powders has been developed. Precision is a function of dispensing time. Less than gram quantities may be dispensed at a rate of about $\frac{1}{3}$ g/min with a precision corresponding to a weight range of about 0.001 g for a series. The process consists in moving powder with the effect of the vibratory motion of a miniature air-powered vibrator. Operation may be controlled manually or automatically with an electronic system interfaced with the weighing unit. (auth)

50494 (RD/B/M-2306) ON THE USE OF INVERSE FUNCTION AMPLIFIERS IN MEASUREMENT. Farrington, B. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Apr 1972. 22p. Dep. NTIS (U. S. Sales Only).

The overall response of a system consisting of a sensor and an appropriate inverse function amplifier (IFA) is discussed. The analysis of such a system was performed for various degrees of mismatching of the IFA to the sensor, using an analog computer to simulate the transfer functions of the appropriate devices. It was established that the basic advantage of using an IFA system compared with a sensor alone was that the effective response time of the sensor could be greatly improved but this was offset by a corresponding degradation of signal to noise ratio. This latter property of the system limited the improvement factor in response time attainable. The results indicate that the system is only of value where response time is of prime concern, e.g. it could form the sensing device for a reactor trip system. The effects of mismatching an IFA used as part of a trip system was considered and the tolerance of the system to mismatching established for a given input profile. (auth)

50495 (Y-1836) OPTIMIZATION OF MULTILAYER THICK-WALLED CYLINDERS WITH SIMULTANEOUS INTERNAL PRESSURE AND RADIAL TEMPERATURE GRADIENT. Huddleston, R. L. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 12 Jul 1972. Contract W-7405-eng-26. 228p. Dep. NTIS.

Thesis. Submitted to the Univ. of Tennessee, Knoxville.

A method has been developed for optimizing the radius and interference design parameters of a multilayer, thick-walled cylinder with independently applied or combined internal pressure and steady-state, radial, thermal gradient loadings. The capabilities are included to permit a set of fixed tangential stresses in each layer to simulate autofrettage, or other residual stresses as well as to allow a fixed, arbitrary, uniformly applied load on the ends of the inner cylinder. The method developed also permits constraining the tangential stress in the inner cylinder to be less than any chosen value. Shrink interferences may be treated as variables or may be fixed at any arbitrary percent of their respective interface radii. Pressure and thermal stresses used in the analysis are from classical elasticity solutions; elastic breakdown is defined by the distortion energy (Mises) yield criterion. Independent material properties are permitted for all layers. Optimization is carried out using a constrained, nonlinear, gradient projection technique whereby design parameters are systematically varied moving from a starting point to the optimum solution in discrete steps along the steepest gradient which does not result in constraint violations. (auth)

50496 HIGH-SPEED ROTATING DEVICES. Barlow, B. V.; Read, R. S. (Smith's Industries Ltd., London). Contemp. Phys.; 13: No. 4, 355-74(Jul 1972).

High-speed rotation provides many facilities which are unattainable by any other process. Very high linear velocities and also exceptionally high force fields can be obtained in the laboratory. The gyroscope can give a reference platform which is stable even within a violently unstable environment. The basic problems are outlined and some of the solutions including biological and gas ultra centrifuges are treated in detail. This review article deals mainly with angular velocities in the range 2000 rad s^{-1} to 63,000 rad s^{-1}. (auth)

50497 METHOD OF MEASURING THE ABRASIVENESS OF AN ABRASIVE FLUID. Lewis, Donald R. (to Shell Oil Co.). U. S. Patent 3,678,273. 18 Jul 1972. Filed 11 Feb 1970.

A method of measuring the abrasiveness of an abrasive fluid by exposing a radioactive abradable material to a flow of the abrasive fluid, and measuring the rate at which radiation is being emitted from the fluid-contacted radioactive abradable material. The decrease due to an abrading away of the radioactive abradable material that occurs in the rate at which the radiation is emitted from the fluid-contacted radioactive abradable material is measured. The amount of abrasion of the abradable material is then used to measure the abrasiveness of the abrasive fluid. (Official Gazette)

50498 APPARATUS FOR IRRADIATION EXPERIMENTS WITH POLYMERIC MATERIALS. Sergeev, V. I.; Deev, Yu. S.; Kruglyi, M. S.; Serenkov, V. I. Fiz.-Khim. Mekh. Mater.; 8: No. 1, 87-9(1972). (In Russian).

An apparatus is described which was designed for conducting experiments in the elongation, creep, and stress relaxation on polymers under various conditions of vacuum, temperature, and ionizing radiation. Provision was made for scheduling constant velocity of deformation, and for atmospheres of either inert or composed of corrosive gases. (K.S.W.)

50499 OPTIMIZATION OF A HEAT PIPE WITH A WICK AND ANNULUS LIQUID FLOW. Hwang-Bo, H. (Fairchild Industries, Germantown, Md.); Hilding, W. E. J. Heat Transfer; 94: No. 2, 196-202(May 1972).

An analytical model has been formulated for the parametric study of liquid flow characteristics in the heat pipe, which consists of a porous tube, a closed outer container tube, and an annulus between them. The analytical model includes the effect of the rate of change of momentum, surface tension forces, the frictional forces in the body of wicking material and at the wall, as well as the axial variation of static pressure supporting the capillary meniscus at the liquid—vapor—wick interface in the vapor passage. The length of the condenser of the heat pipe was optimized as a function of the radial heat flux rate and the ratio of the liquid flow rate in the annulus to that within the wick, W_a/W_w. The effect of pressure loss and recovery in the vapor passage of the heat pipe on the optimum length of condenser was investigated. (auth)

50500 CREEP CELL FOR NUCLEAR REACTORS. Cartier, Louis (to Commissariat a l'Energie Atomique). French Patent 2,087,758. 6 Dec 1971. Filed 29 May 1970. (In French).

This creep cell, positioned inside the nuclear reactor vessel, enables the creep of a test bar to be studied. The behavior of the test bar when subjected to tensile tests and irradiation can be investigated. The following parts are contained in a sealed tubular enclosure: a piston; a cylindrical test bar, having disks at its ends; a reference test bar, having ends pressing against the two disks; a system for making microwave measurements on the resonant cavity. The system is provided with a means of exerting a known variable pressure on this piston, and also means of exerting a known variable pressure on a second piston. In this way, comparative measurements of the deformation of the two test bars are possible. Microwave techniques are used to measure the displacement of the second piston. Dosimeters are used to indicate the irradiation doses received by the test bars. Molten NaK may be used to indicate the irradiation doses received by the test bars. Molten NaK may be used as the coolant for this cell. (France)

50501 TECHNICAL CONSIDERATIONS IN THE CALIBRATION OF LOW ENERGY X-RAY UNITS. Hargrave, N. J. (Commonwealth Radiation Lab., Melbourne). Australas. Bull. Med. Phys. Biophys.; No. 55, 11-20(1 Aug 1972).

Several types of ionization chambers were used to measure the free air output of low-energy (less than 60 kVp) x-ray generators. Typical response curves, determined at the Laboratory, are presented for some of the commercially available instruments. Various physical effects of particular relevance to the calibration of low-energy x-ray generators are discussed; in particular, work done at CRL on the effect of filter position and the SSD of measurement on both air attenuation and half-value thickness is described. The need for precise maintenance of control of these variables as well as kV and mA is stressed. (auth)

50502 DRY COOLER DISCHARGE WATERS. PART 2. Heeren, H.; Holly, L. Energie; 23: No. 12, 385-93(1972). (In German).

The following items concerning cooling tower systems are described: design, operating behavior, control operation at high and low temperatures, automation, and applicability of the system for high power and economy. (GF)

50503 DRY COOLER DISCHARGE WATERS. PART 1. Heeren, H.; Holly, L. Energie; 23: No. 10, 298-305(1971). (In German).

A description is given of the technical details, advantages and disadvantages of two cooling systems: air-cooled surface condensers (direct or GEA-system) and injection condensers with air-cooled water—air heat exchangers (indirect or Heller-system). (GF)

50504 MEASUREMENT OF INHERENT FILTRATION IN DIAGNOSTIC X-RAY TUBES AND THE EFFECT OF TARGET ANGLE ON X-RAY QUALITY. Ardran, G. M.; Crooks, H. E. (Atomic Energy Research Establishment, Harwell, Eng.). Brit. J. Radiol.; 45: No. 536, 599-602(Aug 1972).

Methods described for the determination of inherent filtration, and the discrepancies in the results, are discussed. It is pointed out that output measurements given in handbooks of standard data may be misleading if compared with such data for tubes for which the inherent filtration is in doubt. The importance of the correct effective kV at which measurements are made is discussed. The target angle of the tube has an important effect in altering x-ray quality. If the same target angle is not used for both calibration and measurements, discrepancies can result which can easily lead to an erroneous value of inherent filtration of between 0.25 and 0.5 mm Al equivalent. A procedure is described using a copper reference number method, enabling calibration curves to be obtained so that the inherent or total filtration of an x-ray tube may simply be determined with an accuracy better than 0.1 mm Al equivalent. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 50461, 50480, 50490, 50499, 50761, 51001, 51007, and 52366—52368.

50505 (AEEW-R-757) PRESSURE DROP, HEAT TRANSFER, AND FLOW PHENOMENA FOR FORCED CONVECTION BOILING IN HELICAL COILS: A LITERATURE REVIEW. Hopwood, P. F. (Atomic Energy Establishment, Winfrith (England)). Jan 1972. 33p. Dep. NTIS (U. S. Sales Only).

A review of the literature relevant to forced convection boiling in helical coils is presented, including a discussion of flow phenomena observed in air-water systems. Equations are recommended for the prediction of pressure drop and heat transfer in the econimizer, evaporator and superheater regions of a once-through coil boiler. The possible trajectories of droplets in a coil are discussed, and an extensive bibliography for both single and two-phase flow in coils is presented. (auth)

50506 (AEEW-R-767) EFFECT OF "CRUD" DEPOSITS ON FRICTIONAL PRESSURE DROP IN A BOILING CHANNEL. Macbeth, R. V. (Atomic Energy Establishment, Winfrith (England)). Apr 1972. 15p. Dep. NTIS (U.S. Sales Only).

Pressure drop data are examined which were obtained using annular test sections with the central heated rod first in a clean condition and subsequently covered with a layer of "crud," typical of the deposits that occur in boiling channels. The tests were done with water at 69 bar and with a wide range of mass velocities, inlet subcooling and heat flux levels. The results show that frictional pressure drop is increased about 40% by the presence of "crud" when no boiling takes place. With boiling however, the frictional pressure drop in a "crudded" channel is shown to be only slightly higher than in a corresponding clean channel. This effect is due to the fact that in a boiling channel a large proportion of the total friction can be generated by the drag forces accelerating the entrained liquid in the vapour stream. These drag forces are largely independent of whether the channel is clean or crudded and hence, only a slight difference may be found in the frictional pressure drop values. (auth)

50507 (CISE-R-235) RESEGONE CODE FOR ELABORATION OF THE INSTRUMENT READING OBTAINED ON THE IETI-1 AND IETI-3 INSTALLATIONS AND SUBPROGRAMS FOR CALCULATION OF THE PHYSICAL PROPERTIES OF WATER AND STEAM. Gaspari, G. P.; Milani, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1967. 70p. (In Italian). Dep. NTIS (U. S. Sales Only).

A code for the processing of the instrument read-out relative to thermohydrodynamic experiments on two-phase water—vapor mixtures obtained on the IETI-1 and IETI-3 is reported. The principal characteristics of the Resegone code are the direction of the fluid toward the top and toward the bottom, test channels uniformly heated along the axis and having varied geometry, and tubular channels with rectangular power profiles along the axis. The major part of the subprograms is related to the calculation of the physical properties of the water and vapor in a wide pressure interval from 5 to 160 kg/cm^2 and temperature from 50 to 350°C. (J.S.R.)

50508 (CONF-720622—2) PARAMETRIC STUDY TO ESTABLISH DESIGN CURVES AND TO EVALUATE DESIGN RULES FOR RATCHETTING. Branca, Thomas R.; McLean, John L. (Teledyne Materials Research Co., Waltham, Mass.). [nd]. Contract W-7405-eng-26. 31p. Dep. NTIS.

From Symposium on fatigue at elevated temperatures; Storrs, CT. (18 Jun 1972).

With inelastic analyses requiring a substantially greater expenditure of effort over elastic analyses, there is strong incentive to establish an elastic design criterion for ratchetting that is not excessively conservative and consequently restrictive. To establish the design curves for ratchetting, the ANSYS computer program was used to develop elastic-plastic-creep solutions for several cases of a long, sodium-filled pipe. The pipe was subjected to a fluid temperature history which consists of a rapid down-transient followed by a gradual rise to operating temperature, and a 500 h hold time at that temperature. The parameters of the analytical solutions covered the range of interest for sodium-cooled nuclear systems. The only material considered was 304 stainless steel. Design curves were developed for ratchet strain as a function of elastic primary and secondary stress intensities and temperature. The results of this study indicate that the existing design rules of FRA-152 rev. 3 and of the proposed LMEC revision to the ASME Code Case 1331-5 for loading cycles with long hold times are very conservative, with one exception. That exception is rule A.2.1.2(4) of the proposed revision to the ASME Code. When compared to the results of the study, the rule is consistently and reasonably conservative for all loadings and temperatures studied. (auth)

50509 (INIS-mf—235) RECENT CONTRIBUTIONS TO THE STUDY OF THE LEIDENFROST PHENOMENON. Naso, V. (Naples Univ. (Italy)). 1971. 28p. (In Italian). (CONF-710952—1). INIS.

From Symposium of the Italian Thermotechnical Association; l'Aquila, Italy (21 Sep 1971).

Recent bibliography concerning film boiling of liquid droplets on both still and moving surfaces is reviewed. Present knowledge of the main aspects of the phenomenon is also pointed out. (INIS)

50510 (UCRL—73481) EVAPORATION FROM A CAPILLARY-WETTED SURFACE. Goluba, Raymond W.; VanSant, James H. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 27 Oct 1971. 47p. (CONF-720802—2). Dep. NTIS.

From thirteenth national heat transfer conference; Denver, CO. (6 Aug 1972).

The evaporative cooling of a flat, heated plate by a wetted wick was studied. One end of the wick was placed in a water reservoir to provide capillary wetting. The heated plate was maintained in a horizontal position, and the point at which the wick became dry was determined as a function of applied heat flux at vapor pressures of 9.6, 17.5, and 24 psia. The continuity, momentum, and energy equations that describe the heat- and mass-transfer processes in the wick were written in an integral form and a solution was obtained. The predicted dryout locations agree well with the experimental values when it is assumed that the liquid/vapor interface has receded into the wick. The experimental data indicate that the wick was saturated up to a thickness of only 0.011 in. from the heated plate. (auth)

50511 HEAT AND MASS TRANSFER IN THE VICINITY OF THE VAPOR-GAS FRONT IN A GAS-LOADED HEAT PIPE. Edwards, D. K. (Univ. of California, Los Angeles); Marcus, B. D. J. Heat Transfer; 94: No. 2, 155-62(May 1972).

An analysis is presented of axially conducting gas-controlled heat pipes leading to a predictive capability for the heat and mass transfer along the heat pipe. In addition, experimental results are presented which verify the analysis, and computational results are presented which show the relative influence of various parameters which affect the system behavior. In particular it was found that axial heat conduction is of much greater importance than axial mass diffusion in establishing the wall temperature profiles and condenser heat-transfer characteristics of gas-loaded heat pipes. However, mass diffusion and, consequently, the choice of working fluid and control gas are of considerable importance in establishing the "diffusion freezeout rate" if the potential exists for freezing of vapor which penetrates the gas-blocked portion of the condenser. It is believed that the analysis and associated computer program are useful tools for designing gas-loaded heat pipes. (auth)

50512 BIBLIOGRAFIYA PO TEPLO-I MASSOOBMENU (1967—1969). TOM 1. (Bibliography on Heat and Mass Transfer

1967–1969. Volume 1). Dolinskaya, R. A.; Murashko, V. M.; Birillo, E. P.; Nikitina, L. A. Minsk; Institut Teplo-i Massoobmena (1972). 464p.

Only the Russian literature was drawn upon for the bibliography This volume contains 4186 references and covers the following headings: general, heat conductivity, convective heat transfer, radiant heat transfer, chemical reaction problems, gas transformations and combustion, mass transfer, and aerohydrodynamics. (TSS)

50513 BIBLIOGRAFIYA PO TEPLO-I MASSOOBMENU (1967–1969). TOM 2. (Bibliography on Heat and Mass Transfer 1967–1969. Volume 2). Dolinskaya, R. A.; Murashko, V. M.; Birillo, E. P.; Nikitina, L. A. Minsk; Institut Teplo-i Massoobmena (1972). 412p.

Only the Russian literature was drawn upon for the bibliography. This volume contains 3305 references on aerohydrodynamics, drying processes, kinetic theory of gases and liquids, thermophysical properties of matter, and measurement techniques in transfer processes. The last section (~94 pages) deals with transfer processes at high temperatures and in plasma. (TSS)

Materials Testing

Refer also to abstracts 50782, 50789, 50790, and 51149.

50514 (AEC-tr–7138, pp 60-4) OPTIMUM DIMENSIONS OF THE EXAMINED SECTION IN THE RADIOGRAPHY OF FLAT ARTICLES. Elisyutin, G. P.; Maiorov, A. N.; Tyufyakov, N. D. Translated from Radiats. Tekh.; No. 3, (1969).

Use of optimum dimensions results in reduced exposure time. Exposure time is determined for the corners of the observed section, since this is where the intensity is lowest. It is shown that for any given value of one of the angles there is a value determined for the other that makes the exposure a minimum. Minimum time corresponds to a square section. In some cases, however, it is desirable to examine a narrow band, e.g., a weld, and an equation relating the optimum length for such a case with the material thickness is derived. The total exposure time in cases in which the size of the examined section is not at an optimum is also given. If the gamma radiation used is not monoenergetic, the determination of the optimum characteristics is complicated by the dependence of the linear attenuation coefficient on the thickness of the material examined. (R.W.R.)

50515 (AEC-tr–7138, pp 64-71) EFFECT OF SCATTERED GAMMA RADIATION ON THE QUALITY OF RADIOGRAPHIC PICTURES. Zhukovskii, E. A. Translated from Radiats. Tekh.; No. 3, (1969).

The effect of gamma radiation scattered by surrounding articles on the sensitivity of radiography is discussed. It is found that, when it is not possible to shield the film against scattered radiation or to remove the examined article far enough from scattering articles, the best sensitivity is obtained by reducing the exit angle of the gamma beam at the source and by making the cross section of the beam as similar as possible to the area of the examined section of the article. A number of experiments confirmed the validity of the analytical results. (R.W.R.)

50516 (AEC-tr–7138, pp 142-7) ON THE POSSIBILITY OF DETECTING DEFECTS IN WELDED JOINTS WITH THE AID OF BETA RADIATION. Blinova, O. P.; Kreindlin, I. I.; Mashinin, V. A.; Terskii, R. V. Translated from Radiats. Tekh.; No. 3, (1969).

In the quality control of welded joints with a thickness of $\frac{1}{2}$ to 1 mm it is desirable to use radiation sources having absorption coefficients between 40 and 20 cm^{-1}. Such absorption coefficients are characteristic of soft x rays and beta radiation Results of experiments on the use of beta radiation for the detection of flaws in thin welded joints are presented. Defects with a diameter of 0.3 mm and length of 0.3 mm were reliably revealed in both static experiments and in dynamic experiments at speeds of 3 and 6 m/h. Defects measuring 0.3 × 0.1, however, were revealed only in static experiments with a fairly long counting time. Bremsstrahlung produced in the source, various structural parts, and the sample and variations in thickness along the welded joints were some of the major difficulties encountered. (R.W.R.)

50517 (AEC-tr–7138, pp 196-8) NEW MODEL OF THE RID-21 GAMMA FLAW DETECTOR. Kuleshov, A. V.; Maiorov, A. N.; Sul'kin, A. G.; Valuev, O. V.; Popov, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

The universal RID-21M hose-type gamma flaw detector with a storage-container unit housing the gamma sources is described. It was designed for work under laboratory, plant, dock, airport, and field conditions, at nonreadily accessible sites, in repair and recovery operations, for the control of working equipment in order to reveal operational defects, for the examination of vertical and overhead welded joints, etc. The apparatus does not require external power sources. The maximum thickness of investigated articles was 60 mm for steel and 120 mm for light metals and alloys. (R.W.R.)

50518 (AEC-tr–7138, pp 198-200) "LABIRINT" GAMMA FLAW DETECTOR. Maiorov, A. N.; Kuleshov, A. V.; Sul'kin, A. G.; Valuev, O. V.; Morokin, K. D. Translated from Radiats. Tekh.; No. 3, (1969).

The "Labirint" gamma flaw detector is a universal apparatus of the hose-type comprising a storage-container unit for various radiation sources; it was designed for the radiographic control of butt and corner welds in nonreadily accessible sites under plant or assembly conditions. It may be used for the examination of steels with a thickness up to 60 mm and light metals and alloys with thicknesses up to 120 mm. In automatic operation the transfer of the source to the examination site, the exposure, and the transfer of the source back to the storage unit are effected in accordance with a preset program. The maximum distances from the radiation head to which the sources can be transferred in order to reach the examination site are 10 m (horizontal) and 6 m (vertical). (R.W.R.)

50519 (AEC-tr–7138, pp 200-2) RID-22 GAMMA FLAW DETECTOR. Zhukovskii, E. A.; Sul'kin, A. G.; Glebov, V. N.; Valuev, O. V.; Shtompel, V. A.; Lukashev, N. I. Translated from Radiats. Tekh.; No. 3, (1969).

The RID-22 flaw detector, a completely autonomous semiautomatic apparatus for the examination of steel articles up to 80 mm thick or light-alloy articles up to 300 mm thick, is described. The apparatus employs ^{192}Ir or ^{137}Cs radiation sources. (R.W.R.)

50520 (AEC-tr–7138, pp 203-4) IMPROVED VERSION OF THE "GAZPROM-M" GAMMA FLAW DETECTOR. Khoroshev, V. N.; Maiorov, A. N.; Sul'kin, A. G.; Galash, T. F.; Valuev, O. V.; Sanin, V. P. Translated from Radiats. Tekh.; No. 3, (1969).

The "Gazprom" flaw detector, designed for quality control of welded joints in main pipelines, is described. Joints in steel pipes with a diameter up to 1,220 mm may be examined through two walls with a total thickness up to 40 mm. (R.W.R.)

50521 (AEC-tr–7138, pp 204-6) "TRASSA" GAMMA FLAW DETECTOR. Maiorov, A. N.; Sul'kin, A. G.; Khoroshev, V. N.; Galash, T. F.; Solntsev, V. V.; Povalikhin, N. S.; Bulgakov, G. G. Translated from Radiats. Tekh.; No. 3, (1969).

The "Trassa" flaw detector, for quality control of welds in pipelines, is described. It can be used for examination of welds in pipes with diameters from 720 to 1220 mm and a total wall thickness up to 40 mm. Inside a pipe, the apparatus can be moved a distance up to 30 m with the aid of an electric cart, which can be stopped automatically by a signal from the radiometric transducer. (R.W.R.)

50522 (MLM–1410) FEASIBILITY STUDY FOR THE NONDESTRUCTIVE INSPECTION OF HEAT SOURCES. Kettering, D. D.; Houk, K. L. (Mound Lab., Miamisburg, Ohio). 13 Mar 1967. Contract AT-33-1-Gen-53. 12p. Dep. NTIS. Declassified 26 Oct 1971.

Two ultrasonic methods, a pulse-echo shear technique and a pulse-echo longitudinal technique, were evaluated for the nondestructive testing of the SNAP-19B weld. It was demonstrated that ultrasonic inspection methods are feasible for determination of heat source weld integrity and quality control applications. (auth)

50523 (RFP-Trans–101) EMITTING MATERIALS: STATE OF AFFAIRS OF A VERY PROMISING TECHNIQUE–THE ACOUSTIC EMISSION ANALYSIS. De Kanter, J. C. F. (Technische Hogeschool, Delft (Netherlands)). Translated for Dow Chemical Co., Rocky Flats Div., from a Dutch report. 79p. Dep. NTIS.

Information is included on acoustic emission sources, detection and discrimination of acoustic emission signals, signal interpretation, use of acoustic emission signals in analysis of crack initiation and propagation, uses of acoustic emission signals in non-destructive testing, and a review of activities at various laboratories. (J.R.D.)

50524 (UCRL–51241) SMALL DISPLACEMENT MEASUREMENTS USING HOLOGRAPHIC INTERFEROMETRY. Burger, Michael J. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Jun 1972. Contract W-7405-eng-48. 18p. Dep. NTIS.

Holographic interferometry produced by coherent laser light can be used to detect three-dimensional displacements as small as 12 μin. on a complex curved surface of a structure deformed by either stresses or temperature gradients and displacements caused by solid-body motion. With this technique, the measuring apparatus is independent of the surface being measured which is an advantage over strain-gage or photoelasticity techniques. A computer code was developed to give quantitative and qualitative interpretation in the form of displacement contour lines. (auth)

50525 PROTON RADIOGRAPHY. Cookson, J. A.; Armitage, B. H.; Ferguson, A. T. G. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). Non-Destruct. Test.; 5: No. 4, 225-8(Aug 1972).

The special properties which make proton beams useful for radiography are explained. Individual examples of marginal-range proton radiography, density-profile and porosity measurements and proton-induced x-radiography are given, together with examples of their applications. (auth)

50526 PROFILE RADIOGRAPHY BY GAMMA RAYS. Callister, W. C. (National and Vulcan Engineering Insurance Group, Manchester, Eng.). Non-Destruct. Test.; 5: No. 4, 214-19(Aug 1972).

Profile radiography is an inspection tool which has found use on pipelines, pipe systems, and chemical plants. It can reveal corrosion, erosion, and the accumulation of deposits. The parameters and application of the technique using the highly penetrating gamma radiation of ^{192}Ir and ^{60}Co are described. (auth)

Nuclear Explosions

Refer also to abstracts 50293, 50330, 50611, 51129, and 52405.

50527 (AD–735765) LONG-PERIOD SEISMOLOGICAL RESEARCH PROGRAM. Semiannual Report. Sykes, Lynn R.; Savino, John M. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 25 Oct 1971. Contract F44620-71-C-0082. 18p. (AFOSR-TR–72-158). NTIS.

The most significant finding of the data analysis pertinent to the earthquake-explosion discrimination problem is one based on results from the seismic detection and earth noise studies. Visual examination of high-gain seismograms from CTA, FBK, and the station at Ogdensburg, NJ (OGD), for approximately 1,000 events in the magnitude range from m_b of 3.3 to about 6.5 indicates that surface waves with periods as long as 30 to 40 s are observable after most events, in particular the smallest magnitude events studied (e.g., $m_b = 3.6$ recorded at FBK at epicentral distances of 5 to 10°. (auth) (NTIS)

50528 (AD–735848) PRESHOT GEOLOGIC INVESTIGATIONS, PROJECT SULKY, BUCKBOARD MESA, NEVADA TEST SITE. Nugent, R. C.; Banks, D. C. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Feb 1965. 93p. (AEWES-Misc-Paper–3-703). NTIS.

A comprehensive geologic and engineering investigation was undertaken at the site on Buckboard Mesa selected for the Sulky Event, a planned nuclear cratering experiment to be conducted in dry basalt. Foundation conditions were determined by six borings: one centrally located, 6-in.-dia boring to a depth of 80 ft and five NX-size holes ranging in depth from 59 to 212 ft. (auth) (NTIS)

50529 (AD–736122) TENTATIVE PLACEMENT TECHNIQUE FOR CYLINDERS BURIED IN CLAY SPECIMENS. Perry, E. B. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Dec 1975. 29p. (AEWES-Misc-Paper–3-768). NTIS.

The development of a tentative placement technique for cylinders buried in clay specimens is described. The technique was developed as a support study for tests on small aluminum cylinders buried in compacted, partially saturated buckshot-clay specimens in the Small Blast Load Generator. (NTIS)

50530 (AD–736124) PRESHOT INVESTIGATIONS FOR PROJECT PRE-SCHOONER, BUCKBOARD MESA, NEVADA TEST SITE. Nugent, R. C.; Banks, D. C. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Sep 1965. 139p. (AEWES-Misc-Paper–3-783). NTIS.

A comprehensive geologic and engineering investigation was undertaken on Buckboard Mesa at the four sites selected for Project Pre-Schooner, a series of chemical explosive experiments conducted in dry basalt. The results of the preshot geologic and engineering investigation are presented. Subsurface conditions were determined from four vertical borings at each site: One centrally located 6-in.-dia boring to a depth of 80 ft and three satellite NX core holes of variable depths at the ends of 35-ft radials that were spaced 120° apart. The sites are blanketed by a thin soil cover of rather uniform thickness, ranging from 2 to 4 ft at the four sites, overlying a basalt cap approximately 200 ft thick. The uppermost portion of this basalt cap is composed of vesicular basalt 25 to 50 ft thick which grades into underlying dense basalt 100 to 150 ft thick. The basalt is immediately underlain by 0 to 20 ft of ash or cider beds. (NTIS)

50531 (AD–736270) MINERAL ROCK EJECTA STUDY. Final Report. Stroberger, Dan E. (Boeing Co., Seattle, Wash.). 16 Dec 1971. Contract DASA01-70-C-0029. 117p. (DNA-2743-P). NTIS.

Event Mineral Rock, a 100 ton H. E. surface burst on granite provided an assortment of crater debris data. Analysis of these data produced the following: a size-to-weight relation, given either the length, area, or volume of a particle; a given size subgroup within the range of "fine" (.476 in) particles represents an increasing cumulative percent of existing fine debris as radial distance increases; rock breaks up fairly randomly; normalized ratios of width to length and thickness to length are less than .7 and .4, respectively; particles become longer and thinner with increasing weight; an aerial photo study tends to define rocks longer than they are. (auth) (NTIS)

50532 (AD–736852) FALLOUT PREDICTION PROCEDURE FOR SUBSURFACE ADM'S. Snell, Charles; Burton, Donald; O'Connor, John (Army Engineer Explosive Excavation Research Office, Livermore, Calif.). Sep 1971. 124p. (EERO-TR–22). NTIS.

Simplified and detailed methods are presented for predicting exposure rates due to fallout from underground nuclear detonations. The simplified method, which is performed by hand calculations, predicts generalized exposure rate contours in the upwind-crosswind and downwind areas. The detailed method, which can be accomplished by either a hand calculational procedure or a nomogram procedure, predicts generalized exposure rate contours in the upwind-crosswind area and detailed exposure rate contours in the downwind fallout area. All procedures are based on a graphic-numerical scaling model. The quantity predicted by these procedures is the (H + 1) hour exposure rate, in R/hr. Time dependent exposure rates, total radiation doses, and the Army-defined hazard zone boundaries may also be predicted if desired. (auth) (NTIS)

50533 (AD–737092) SEISMIC DISCRIMINATION. Semiannual Technical Summary Report, July 1–December 31, 1971. Davies, David (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). 31 Dec 1971. Contract F19628-70-C-0230. 75p. (ESD-TR–71-325). NTIS.

New short-period data on source functions both of explosions and earthquakes are reported. Studies of wave propagation in inhomogeneous regions of the earth are described. First results from NORSAR are presented. Long-period noise and signal observations have been made, and some idea of NORSAR's discriminative capability is emerging. Network approaches to discrimination are being expanded. Major improvements in P-wave detection capability are in sight, with joint array and network analysis. New programs are being applied to the rapid acquisition of library information on seismic events. An increasing use of LASA for other geophysics projects is apparent. (auth) (NTIS)

50534 (AD–737178) APPLICATION OF FINITE-ELEMENT METHOD IN DETERMINING STABILITY OF CRATER SLOPES. Final Report. Palmerton, John B.; Banks, Don C. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Jan 1972. 131p. (AEWES-Misc-Paper-S–72-2). NTIS.

The investigations reported comprise studies to evaluate applicability of the finite element method to stability analysis of explosively excavated slopes. A finite element program based on nonlinear material properties was developed during this study. The program incorporates a capability to simulate incremental construction of slopes of arbitrary geometry either by excavation or by building up. The stress-strain relationships of materials forming the slope and its foundations are approximated by hyperbolic curves. The hyperbolic curves are asymptotic to the yield strength of the materials as defined by Mohr – Coulomb strength parameters. Initial states of stress may be incorporated into the analyses. Several examples of simple slopes under various initial states of stress were analyzed. Additional examples were a symmetrical, homogeneous embankment on a rigid foundation and hypothetical row crater excavation slope. Stresses and displacements for the different examples are presented along with a method for determining the factor of safety of a slope from nonlinear stress analysis. (auth) (NTIS)

50535 (AD–737198) PROJECT PRE-GONDOLA III, PHASE III: CONNECTION OF A ROW CRATER TO A RESERVOIR. Redpath, Bruce B. (Army Engineer Explosive Excavation Research Office, Livermore, Calif.). Aug 1971. 25p. (EERO-TR–38; PNE–1120). NTIS.

Project Pre-GONDOLA III Phase III, the connection of a row crater to a reservoir, was executed on Oct. 6, 1969 and was the culmination of several years of cratering experiments in saturated clay shale near Fort Peck, Montana. This experiment used a total of 70 tons of an aluminized ammonium nitrate blasting agent in a row of five charges to remove a barrier between an existing row crater and the Fort Peck Reservoir. The excavation resulting produced by the detonation had a volume of about

63,000 yd^3. The blasting agent appears to have a cratering effectiveness approximately 1.6 times that of TNT. (auth) (NTIS)

50536 (AD–738138) OPERATION PRAIRIE FLAT, PROJECT LN 302: EARTH MOTION AND STRESS MEASUREMENTS. Murrell, Donald W. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Feb 1972. 175p. (AEWES-TR-N-72-2). NTIS.

Results of a study are presented, the objectives of which were to measure and interpret the earth motions and stresses produced by the Prairie Flat 500-ton TNT detonation. Acceleration, particle velocity, and soil stress gages were installed to measure the ground motions and stresses encompassed by the 2,000- to 10-psi predicted airblast overpressure region (84 to 1,150 feet from ground zero) and depths below the ground surface of 1.5 to 30 feet. Time histories of all successful measurements are included. Ground shock arrival times indicated the occurrence of outrunning ground motion at a distance of about 560 feet, or the 35-psi pressure level. (auth) (NTIS)

50537 (AD–738329) UTILITY OF TSAI'S METHOD FOR SEISMIC DISCRIMINATION. Semiannual Technical Report No. 1. July 1–December 31, 1971. Tsai, Yi-Ben (Texas Instruments Inc., Dallas). 15 Jan 1972. Contract F44620-71-C-0112. 42p. (AFOSR-TR-72-516). NTIS.

The objective of the program is to study how the surface wave spectral analysis technique can be most effectively exploited to discriminate between earthquakes and underground nuclear explosions. The observed surface wave spectra are often contaminated by modulations caused by interference due to multipath propagation. These spectral modulations are not related to the characteristics of the seismic source, which is the prime concern, and so, our first task is to find an effective means for removing the undesirable modulations of the spectra. (auth) (NTIS)

50538 (CEA-R–4257) RESEARCH ON THE GEOLOGICAL EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS IN A GRANITE RANGE OF THE SAHARA. Faure, Jean (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). May 1972. 275p. (In French). Dep. NTIS (U. S. Sales Only).

A three-part summary is presented which describes: the geological study of the Hoggar blasting site (Taourirt Tan Affela granite range and overhanging crystalline schists); analyses of the geological effects of underground nuclear explosions in the range (general conditions of the study-surface damage, analysis of fracturing, permeability of the zones affected, and petrographic and mineralogical transformations); geological implications of the studies on underground nuclear explosions, comparison with impactites and details on the metamorphism of the shock. (auth)

50539 (ORNL–4775) THEORETICAL EVALUATION OF CONSUMER PRODUCTS FROM PROJECT GASBUGGY. FINAL REPORT. TRITIUM BEHAVIOR IN A NATURAL GAS PROCESSING PLANT. Kelly, M. J.; Barton, C. J.; Meyer, A. S.; Chew, E. W.; Bowman, C. R. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 44p. Dep. NTIS.

An experiment was performed in a small natural gas processing plant near Big Lake, Texas, to study the behavior of tritium during the processing of natural gas containing tritiated hydrocarbons. Approximately 40,000 ft^3 of natural gas drawn from the Project Gasbuggy well was transported to the plant in two tank trucks. This gas, containing 12.5 mCi of tritium, was diluted with 1,800,000 ft^3 of field gas during a 12-hr period. The tritium activity in the diluted gas entering the plant and in the output gas was measured continuously during the experiment with on-line monitors. Samples of gas and liquid plant products were taken periodically and transported to Oak Ridge National Laboratory or to a commercial laboratory for analysis. Additional tritium (about 70 mCi) in the form of HT was added to the fuel gas being burned in plant boilers or compressors during the test to raise the tritium level in the plant atmosphere to detectable levels. Analysis of 30 samples of atmospheric moisture collected during the test showed a maximum concentration of tritium in air of 131 pCi/m^3, which would give a calculated whole-body dose of 0.06 millirem for continuous exposure during a normal working year (2000 hr). Analysis of urine samples from people present in the plant during the test showed a maximum individual dose commitment of 0.65 millirem, which may have resulted from a small escape during transfer of the tritium used to spike the fuel gas. Plant operators received small or undetectable tritium dose commitments during the experiment. The observed tritium distribution among plant products followed the pattern predicted by pre-test calculations. There was no evidence of isotopic exchange that would cause a buildup of tritium in the plant processing oil. The test results suggest that plant processing of gas from nuclearly stimulated wells will result in doses less than 1% of natural background to plant operating personnel and no other operating problems. (auth)

50540 (UCRL-Trans–10615(Pt.3)) RESEARCH ON GEOLOGIC EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS IN A SAHARA GRANITE MASSIF. Faure, Jean. Translation of a French report. 155p. Dep. NTIS.

The geologic implications of studies of underground nuclear explosions in Sahara test-site granites and experimental results on the behavior of granite under the action of explosion shock waves are discussed. (L.C.L.)

50541 (UCRL-Trans–10616-3) RADIOACTIVITY AND ITS FRACTIONATION DURING UNDERGROUND NUCLEAR EXPLOSIONS IN A GRANITE MEDIUM. Cohen, P. Translated for Univ. of California Lawrence Livermore Lab., from report IAEA-PL–388/9. 24p. Dep. NTIS.

Results are presented for samples obtained from underground shots in the Sahara. The sampling methods for gases and solids are described. The evolution of the radioactive component of the gases as a function of sampling times and sites is discussed (tritium, ^{37}Ar, fission gas). Certain activation products have been determined (tritium, ^{45}Ca, ^{37}Ar). The homogeneity of fission products and fissionable materials in vitrified samples has been confirmed in granite, the vitrified mass of which is 1300 t/kt. (auth)

50542 (UCRL-Trans–10617-1) SCIENTIFIC AND INDUSTRIAL APPLICATIONS OF NUCLEAR EXPLOSIONS: SAFETY PROBLEMS. Barthoux, A.; Cluchet, J.; Gerard, R.; Hubert, M. Translated for Univ. of California Lawrence Livermore Lab., from Bull. Inform. Sci. Tech. (Paris); No. 149, 53-68(Jun 1970). 43p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 10743.

50543 (UCRL-Trans–10617-3) UNDERGROUND NUCLEAR EXPLOSIONS. A Study of the Zones of Fracturing. Derlich, Serge. Translated for Univ. of California Lawrence Livermore Lab., from report CEA-R–3941. 42p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 22824.

50544 (UCRL-Trans–10617-4) EXPERIMENTAL CONDITIONS OF THE 1961–1966 FRENCH UNDERGROUND NUCLEAR EXPLOSIONS IN THE SAHARA. Duclaux, Francoise; Michaud, Lucien. Translated for Univ. of California Lawrence Livermore Lab., from Compt. Rend., Ser. A, B; 270: 189-92(12 Jan 1970). 7p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 14055.

50545 (UCRL-Trans–10617-5) DISTRIBUTION AND EVOLUTION OF RADIOELEMENTS AFTER A NUCLEAR EXPLOSION. Dupuis, M. Translated for Univ. of California Lawrence Livermore Lab., from Bull. Inform. Sci. Tech. (Paris); No. 149, 41-52 (Jun 1970). 22p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 10742.

50546 (UCRL-Trans–10617-6) UNDERGROUND NUCLEAR EXPLOSIONS: A STUDY OF THE MINERALOGICAL TRANSFORMATIONS. Results from the Sahara Explosion Site. Faure, Jean. Translated for Univ. of California Lawrence Livermore Lab., from report CEA-R–3990. 35p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 41467.

50547 (UCRL-Trans–10617-8) PHYSICS OF THE PHENOMENA IN THE CLOSE-IN ZONE AROUND UNDERGROUND NUCLEAR EXPLOSIONS. Maury, Jacques; Levret, Clet. Translated for Univ. of California Lawrence Livermore Lab., from report CEA-R–3850. 64p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 2330.

50548 (UCRL-Trans–10617-9) CODE S CALCULATION OF THE EFFECTS OF CONTAINED UNDERGROUND EXPLOSIONS. PART ONE. METHOD OF CALCULATION. Maury, Jacques. Translated for Univ. of California Lawrence Livermore Lab., from report CEA-R–3957(1). 95p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 39095.

50549 (UCRL-Trans–10617-10) MECHANICAL EFFECTS OF CONTAINED UNDERGROUND NUCLEAR EXPLOSIONS. Supiot, F. Translated for Univ. of California Lawrence Livermore Lab., from Bull. Inform. Sci. Tech. (Paris); No. 149, 17-28(Jun 1970). 27p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 10741.

50550 (UCRL-Trans-10617-11) CALCULATION OF THE SHOCK WAVE IN THE CLOSE-IN ZONE OF AN UNDERGROUND NUCLEAR EXPLOSION (CADES METHOD). Supiot, Francis; Brugies, Jacques. Translated for Univ. of California Lawrence Livermore Lab., from report CEA-R-3736. 29p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 31441.

50551 ACTIVITY OF ^{181}W AS A FUNCTION OF TIME WITHIN A NUCLEAR CRATERING CLOUD. Gudiksen, P. H. (Univ. of California, Livermore). Health Phys.; 23: No. 3, 355-62(Sep 1972).

Project Schooner was a nuclear experiment conducted at the U. S. Atomic Energy Commission's Nevada Test Site during December 1968 as part of the Plowshare Program for development of nuclear excavation. The large dust cloud generated by the detonation contained numerous radionuclides, including ^{181}W. Filter samples were collected at elevated levels within the cloud as early as 12 min after cloud formation. Surface air and deposition samples were also obtained, to a distance to 500 km downwind from the detonation point. A numerical model was developed to account for the observed rate of change of ^{181}W concentrations during the first 12 h after the detonation. The model, for which the 12-min concentrations and particle size distributions are input data, incorporates the effects of atmospheric diffusion in the three spatial dimensions of gravitational settling of particles within discrete size groups, of distortion of the cloud due to the vertical profile of the horizontal winds, and of the deposition of the particles on the earth's surface. The calculation indicates that the ^{181}W concentration profile of the cloud at 70 min has features similar to those measured, although some of the inhomogeneities are not accurately reproduced by the model. Calculated concentrations generally agree within a factor of 2 with measured concentrations. The calculation also agrees within a factor of 3 with the ^{181}W activities shown by the samples collected at various elevations between 1 and 4 h after cloud formation. Likewise, the activities measured by the surface air samplers during cloud passage are within a factor of 3 of those calculated. The surface deposition levels are reproduced to within about a factor of 5 of those measured; this disparity may be due to incomplete knowledge of the fall velocities of the particles. The rate of change of the measured cloud burden of ^{181}W can be reproduced to within 30% by the model. (auth)

Protective Structures and Equipment

Refer also to abstracts 50463 and 51008.

50552 (AD-850286) PROTECTIVE CONSTRUCTION CONCEPTS. Final Report. Parsons, Ralph M. (Parsons (Ralph M.) Co., Los Angeles, Calif.). 1 Nov 1968. Contract F49604-68-C-0089. 329p. NTIS.

Protective construction concepts to protect personnel, weapons, and equipment from attack from nuclear weapons contained in the current threats (surface-to-surface and air-to-surface weapons) are developed. Direct hits and the effects of near misses are discussed. (NTIS)

50553 (ARH-SA-137) IN-PLACE EFFICIENCY TESTS OF A LARGE SCALE VENTILATION EXHAUST FILTER. Grady, B. J. Jr.; Henry, K. H. (Atlantic Richfield Hanford Co., Richland, Wash.). 17 Jul 1972. Contract AT(45-1)-2130. 13p. (CONF-720823-3). Dep. NTIS.

From 12th air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

The in-place efficiency of the main ventilation system exhaust filters now in use at the Hanford Purex Plant was determined by three independent test methods. Comparative evaluations of the test methods employed and their corresponding results are made. (auth)

50554 (CONF-720906-1) ATTENUATION OF SHOCK WAVES IN LONG PIPES BY ORIFICE PLATES, ROUGH WALLS, AND CYLINDRICAL OBSTACLES. Dresner, L.; Chester, C. V. (Oak Ridge National Lab., Tenn.). Mar 1972. 12p. Dep. NTIS.

From third international symposium on the military applications of blast simulators; Schwetzingen, West Germany (19 Sep 1972).

The use of an underground grid of large interconnecting tunnels which permit movement of people and supplies as blast protection for urban populations is being considered. The attenuation of shock waves in long pipes was investigated experimentally in an effort to find a less expensive and less cumbersome method than air locks or blast doors as a means of preventing shock waves from reaching the interior of such a tunnel complex. Experiments were performed using 4 in.-dia iron pipes of approximately 3, 8, and 14 ft-lengths to simulate the tunnels and the detonation of explosive mixtures of oxygen and propane to simulate the blast. The equipment and methods are described in detail. Measurements were made of the peak overpressures along the length of the shock tube for the following conditions; bare tube; tube with orifice plates having different inner diameters and spaced at varying distances along the tube length; tube with threaded interior wall; and tubes with variously spaced cylindrical obstacles (aluminum dowels). Graphs of the experimental data for all conditions are presented and indicate that the greatest attenuation of shock waves in long pipes was achieved by baffling with closely spaced, smaller inner diameter orifice plates. (L.C.L.)

50555 (INIS-mf-160, pp 487-505) USE OF HIGH-EFFICIENCY PARTICULATE FILTERS FOR AIR POLLUTION CONTROL WITH SPECIAL REFERENCE TO NUCLEAR INDUSTRY. Khan, A. A.; Thomas, K. T. (Bhabha Atomic Research Centre, Bombay (India)). 1971. (CONF-700847-3). INIS.

From Seminar on pollution and human environment; New Delhi, India (26 Aug 1970).

High-efficiency particulate filters have been developed at the Bhabha Atomic Research Center, Trombay, for air pollution control in nuclear installations. Basically, these are paper filters folded into pleats separated by corrugated spacers. The mechanism of particulate filtration of these filters is briefly described and compared with other air cleaning devices. The economic aspects of the use of these filters are discussed. Special considerations required for installation and in-situ testing of these filters are detailed. It is pointed out that for any finely divided air-borne material which has to be removed to levels below 0.2 mg/m^3, high-efficiency filters are probably the only means of cleaning. The maximum allowable concentration of some of the most toxic industrial dusts and radioactive materials is presented. (INIS)

50556 (INIS-mf-160, pp 506-17) AIR SAMPLING FILTER MEDIA, THEIR CHARACTERISTICS AND USE. Khan, A. A.; Ramarathinam, K.; Thomas, K. T. (Bhabha Atomic Research Centre, Bombay (India)). 1971. (CONF-700847-2). INIS.

From Seminar on pollution and human environment; New Delhi, India (26 Aug 1970).

A brief summary of various types of filter media that are commonly used for air sampling, their suitability and limitations are presented. A brief review of various properties as evaluated in the laboratory and in the field is presented. Properties and uses of certain air sampling media developed at the Bhabha Atomic Research Center, Trombay, are also given. The sampling filter media developed here are made of asbestos, cellulose, and glass fiber with varying compositions. The results of the evaluations are compared with CWS-6 and HV-70 air sampling filter media in use in radioactive installations and suggestions are made regarding the possible uses of locally made filter media as a substitute for the presently imported ones. The mechanism of particulate filtration in air sampling media is briefly discussed. (INIS)

50557 (ORNL-TM-3916) HOW TO MAKE AND USE A HOMEMADE, LARGE-VOLUME, EFFICIENT SHELTER-VENTILATING PUMP: THE KEARNY AIR PUMP. Kearny, C. H. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 26p. Dep. NTIS.

Detailed instructions for construction and use of a Kearny Air Pump (KAP) for large or small shelters are given. The KAP is a simple device similar to a window frame with flaps that open and close by air pressure. The frame is hinged in a wall opening and swings like a pendulum. During its power stroke the KAP's flaps are closed enabling air to be pulled inside the shelter. On the return or outward swing the flaps are opened by air pressure, and the pumped air stream, due to its inertia, continues to flow in the pumped direction. (T.D.)

50558 (UCRL-73800) FIRE PROTECTION OF HEPA FILTERS BY USING WATER SPRAYS. Gaskill, J. R.; Murrow, J. L. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Jul 1972. 21p. (CONF-720823-2). Dep. NTIS.

From 12th air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

In experiments with a full-size section of an exhaust-ventilation system at the Lawrence Livermore Laboratory, fine water sprays used in conjunction with metal screen scrubbers and demisters successfully protected HEPA filters against hot fire gases. When a single HEPA filter was used, at an air-flow rate of 1000 cfm, temperature was reduced from 1500 to ~300°F, with 4 gpm of water distributed through three nozzles. Variations in the heat and flow parameters, and in the spray and scrubber systems used, are described. (auth)

50559 (UCRL-73815) HEPA-FILTER TESTING: COMPARISON OF DOP AND NaCl AEROSOLS. Murrow, J. L.; Nelson, G. O. (California Univ., Livermore. Lawrence Livermore Lab.). 11 Jul 1972. 9p. (CONF-720823-7). Dep. NTIS.

From 12th air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

The penetration of high-efficiency-particulate-air (HEPA) filters by test aerosols of sodium chloride (NaCl) and dioctyl phthalate (DOP) was measured. The purpose was to study the NaCl method for testing the efficiency of these filters and to compare the NaCl method with the DOP method. The NaCl-aerosol generator was built using the standard British system as a guide, but it included some modifications to the sampling and photometric-readout systems. The generator produced polydisperse particles with a diameter of 0.68 μm in a range of 0.02 to 2 μm. The thermal DOP-aerosol generator (0.3 μm) was located at the Hanford Environmental Health Foundation. Thirty-two filters were tested using both aerosols. In general, the penetration of the DOP through the filter was about two times greater than NaCl at both 200 and 1000 cfm (rated flow). The NaCl, although not as penetrating as the DOP aerosol, could be used effectively to test the efficiency of HEPA filters in the 0.001 to 5% penetration range. (auth)

50560 EQUIPMENT FOR THE SEALED JOINING OF TWO ENCLOSURES. Jossoud, Michel (to Commissariat a l'Energie Atomique). French Patent 2,070,482. 16 Aug 1971. Filed 5 Dec 1969. (In French).

A device for connecting two parallel enclosures (e.g., gloveboxes) having openings of the same dimensions is described. Each opening is surrounded with a flange fixed to the outer face of the enclosure wall. A shutting-off device fitted into this flange is used to close the openings. Annular seals are mounted between the flanges and the shutting-off devices. The outer faces of the flanges and the shutting-off devices are provided with neck shaped parts. In this way four joints are formed between the two flanges and the two shutting-off devices, the joints being effected in two perpendicular planes. (France)

50561 LEAD SHIELD CAVE FOR LOW-LEVEL GAMMA-RAY SPECTROMETRY. Michijima, Masami; Miyake, Hiroshi (Kobe Univ., Japan). Kobe Shosen Daigaku Kiyo. Dai-2rui. Kokai, Kikan, Rigaku-hen No. 19, 133-7(Mar 1972). (In Japanese).

A 100mm thick lead shield cave of 1300 × 1300 × 1800 mm inner size was constructed for gamma-ray spectrometry of low levels of radionuclides in marine environmental samples. An assay of iron and lead samples was carried out to choose superior shielding materials. Natural background spectra measured with a Ge(Li) detector under various shielding conditions were compared. (auth) (Japan)

50562 STUDIES ON IN-PLACE TEST OF HIGH EFFICIENCY PARTICULATE AIR FILTER SYSTEMS. Yoshida, Yoshikazu (Japan Atomic Energy Research Inst., Tokai); Ikezawa, Yoshio; Kozuka, M. Kuki Seijo; 8: No. 7, 54-65(Mar 1971). (In Japanese).

The major problems associated with experimental studies of in-place testing of high-efficiency particulate air filter systems using DOP particles are discussed. Characteristics of DOP particle generators developed for in-place tests were examined in the experiment. The mixing efficiency of the particles using various mixing techniques was measured, and aerosol concentration was estimated by averaging sample concentration at three points, using an actual size filter system. The performance efficiency and required extent of mixing are discussed. It was found that the DOP particle generators had adequate stability. The experiment showed no appreciable variation of particle size distribution, when mixing was carried out by various means. Using a distance of 5 times the duct diameter between nozzle position and sampling position resulted in a mixing efficiency independent of nozzle geometry. Mixing fans and orifices seemed to offer good mixing when properly used. A charcoal filter was incapable of filtering the DOP particles. Three-point sampling and the averaging method of concentration reduced the maximum total error of permeability from 170% to 12% on upstream side, and from 140% to 12% on downstream side of filter, and proved to be a promising estimation method. The relation between total collection efficiency and total error of permeability at a given detection level is discussed. (Japan)

Safety Engineering

Refer also to abstracts 50467, 50869, 50897, and 52411.

50563 (JAERI-Memo-4068) CHARACTERISTICS OF RADIOACTIVE AEROSOL RELEASED BY CUTTING OF IRRADIATED FUELS. Yamamoto, H.; Matsui, H.; Yoshida, Y.; Kokubu, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1970. (In Japanese and English). NTIS (U. S. Sales Only).

Metallurgical tests on irradiated natural uranium fuels of the JAPCO's Tokai Reactor were carried out at the Hot Laboratory, JAERI. During cutting of the fuels, airborne fission products in the fuel were dispersed in the cave and were discharged to the exhaust system. The concentration of airborne fission products in the cave, in the exhaust ducts and in the stack were assessed by the air sampling. The size distribution of airborne particles was measured using beta autoradiography. Collection efficiency of typical airborne fission products for three types of sampling medium, that is, cellulose asbestos filter paper (HE-40), charcoal-loaded filter paper (CP-20B) and charcoal cartridge, and also the dispersion factor during cutting in the cave and removal efficiency of the exhaust air filtering system for fission products were obtained. The dispersion factor was from 10^{-5} to 10^{-3} depending on the volatility. The removal efficiency of the exhaust air filtering system was found to be 80% for ^{131}I and 97% for semi-volatile fission products. The mass median dia of the particulate fission products collected on the filter paper was 3.2 μ. Problems in estimating the concentration of airborne fission products and in determining the size distribution of radioactive aerosols are discussed. (auth)

50564 (RFP-1565) FIRE TEST FACILITY AT ROCKY FLATS. A Status Report. Domning, W. E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 8 Apr 1970. 25p. (CRDL-950371-6). Dep. NTIS.

A fire test facility has been constructed at Dow, Rocky Flats, consisting of a glovebox and filter plenum containing 12 filters. The purpose of this facility is to study the effect of a fire originating within the glovebox on the entire glovebox system which includes the filter plenum. The details of construction of the facility are shown and the results of several experiments are discussed to show the capability of the facility. Two of these experiments consisted of burning a full-scale glovebox. Air temperatures leaving the burning box were found to be from 1530 to 1620°F. A third experiment consisted of a test of a water spray-cooled baffle inserted in the filter plenum. This baffle was effective in cooling 1672°F incoming air to 125°F within one minute after actuation. The objectives and brief outlines of future experiments to be done in the facility are also discussed. (auth)

50565 MEASUREMENT TECHNIQUES FOR SAFETY MEASURES. Maushart, R. (Berthold/Frieseke GmbH, Karlsruhe, Ger.). Strahlenschutz Forsch. Prax.; 11: 14-20(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Measurement techniques for safety measures which indirectly or directly serve to determine the personnel dose exposure to be expected by civil radiation accidents are described. Organizational measures which are closely related to the employment of the measuring instruments or to data evaluation are also discussed. (INIS)

50566 NUCLEAR ACCIDENT. EMERGENCY PLANNING AND URGENT MEASURES. Renfer, H. R. Strahlenschutz Forsch. Prax.; 11: 96-100(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

The safety plan for nuclear facilities has to be complemented by an emergency plan. A proposal is made as to the organization of an emergency plan in the Federal Republic of Germany. The necessary measures, including those for personnel and material, are set forth chronologically. (INIS)

50567 DESIGN OF A THIN SHELL NUCLEAR CONTAINMENT VESSEL FOR SEISMIC LOADING. Hagstrom, J. (Chicago Bridge and Iron Co., Oak Brook, Ill.). J. Eng. Ind.; 94: No. 3, 803-6(Aug 1972).

A procedure is presented for the design of a steel nuclear containment vessel subject to seismic loads. A design spectra representation of the loadings is used with a cantilever beam model of the vessel. The results for the beam model are compared with results from two independent shell analyses; a shell model analysis and a nonlinear shell time history analysis. The beam results are shown to provide a good design correlation. (auth)

50568 NONLINEAR SEISMIC ANALYSIS OF THIN REACTOR CONTAINMENT VESSELS. Citerley, R. L. (Anamet Labs., San Carlos, Calif.); Ball, R. E. J. Eng. Ind.; 94: No. 3, 925-9(Aug 1972).

A comparison between the linear and nonlinear seismic analysis of a thin unreinforced steel reactor containment vessel is presented. The effects of the nonlinear coupling between the low Fourier harmonic excitations and the higher Fourier harmonics producing an ovalling response are examined. Imperfection shapes of the containment vessel are employed to provide the mechanism for this response. (auth)

Vacuum Engineering

Refer also to abstract 51227.

50569 VERTICAL ROTOR VACUUM PUMP WITH MAGNETIC CENTERING. Rousseau, Marcel-Gustave; Berthoumieux, Robert (to Commissariat a l'Energie Atomique. Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). French Patent 2,086,525. 6 Dec 1971. Filed 1 Apr 1970. (In French).

A turbomolecular pump (secondary vacuum of the order of 10^{-11} torr) in which the transmission of the axial forces of the spindle to the pump casing and the spindle centering are effected in a simple, but extremely accurate manner is described. The rotor of this pump is fixed to a spindle, which rotates about its axis. The spindle is maintained in the vertical position by a thrust bearing; it is centered by a magnetic-bearing, the latter being provided between the spindle and the casing and situated on the other side of the rotor. The thrust-bearing is situated on the primary vacuum side (10^{-3} torr) of the rotor. In this way, the degassing effect is minimized and the risk of contaminating the secondary vacuum with the vapor of the lubricant is also minimized. (France)

50570 DEVICE FOR SUPPORTING AND CENTERING A HIGH VELOCITY VERTICAL ROTOR. APPLICATION TO A TURBOMOLECULAR VACUUM PUMP. Rousseau, Marcel-Gustave; Berthoumieux, Robert (to Commissariat a l'Energie Atomique. Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). French Patent 2,086,526. 6 Dec 1971. Filed 1 Apr 1970. (In French).

A device is presented for supporting and centering a high velocity rotor. The device consists, essentially, of a thrust-bearing fixed to the spindle and two centering magnetic semi-bearings provided on each side of this spindle. An application to turbomolecular vacuum pumps (primary vacuum 10^{-3} torr, secondary vacuum 10^{-11} torr) is presented. (France)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 50317, 50593, 50594, and 51129.

50571 (AAEC/LIB/Bib–349) URANIUM MINING AND PROCESSING IN AUSTRALIA. A Bibliography. Geue, P. Jean (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1972. 17p. Dep. NTIS (U. S. Sales Only).

Ninety-seven references covering the period 1952 to April 1972 are listed. Arrangement is alphabetical by author within each year. (Australia)

50572 (INIS-mf–67) URANIUM AND THORIUM: 1969. Mineral Review Preprint No. 54. Williams, R. M. (Department of Energy, Mines and Resources, Ottawa (Ontario). Mines Branch). Jun 1970. 13p. INIS.

During 1969, Canadian uranium production continued to come from four operations (Denison Mines Ltd., Rio Algom Mines Ltd., Stanrock Uranium Mines Ltd., and Eldorado Nuclear Ltd.) in two producing areas near Elliot Lake, Ontario, and Uranium City, Saskatchewan. Preliminary figures indicate that 3,855 short tons of U_3O_8, valued at $49,665,506, were produced. All four of these producers as well as some past-producers and one new operation have made plans to expand, reactivate, and begin production, respectively when markets permit. Activity in uranium exploration in Canada continued during 1969; by the end of December 1969, 82 new exploration permits had been issued by the Atomic Energy Control Board, making a total of over 200 issued since January 1967. It is expected that exploration activity will level off during 1970 and that it may even decline slightly as a result of the temporary lull in the uranium market. Eldorado Nuclear Limited continued to be Canada's only producer of refined uranium products. Production of natural ceramic UO_2 powder reached a record 246 tons of equivalent U_3O_8 in 1969. Smaller quantities of other refined uranium products, including natural uranium metal and alloys, depleted and enriched uranium products, and some high density oxide and alloy fuels, have also been produced for domestic and export markets. Construction of Eldorado's uranium hexafluoride plant continued through 1969. The plant will have a capacity to convert 2,500 tons of U_3O_8 to UF_6 per year. A growing market for the uranium industry is predicted beginning in the mid 1970's. There was no production of thorium concentrates in Canada during 1969. However, Rio Algom Mines Ltd. continued shipments of thorium sulphate (thorium cake) graded from 35 to 40 percent ThO_2 from its inventory. The amount shipped was 29,014 pounds, valued at $55,127. Although a minor increase in demand can reasonably be anticipated for thorium due to current and new industrial uses, a major increase in thorium consumption must await the full development of breeder and near-breeder reactor technology Canadian reserves of thorium are substantial, and being intimately associated with uranium in the Elliot Lake and Agnew Lake uranium deposits, will be readily available to meet a major portion of this potential market. (INIS)

50573 (INS–J–129) XENON ANOMALY IN TELLURIUM ORE. Takagi, J. (Tokyo Metropolitan Univ. (Japan)); Tanaka, S. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 15 Jul 1971. 12p. INIS.

A new experimental approach to solve the problem of the ^{129}Xe anomaly in tellurium ores is proposed and discussed. The method is based on the determination of ^{129}I/^{129}Xe ratio in tellurium ores with various ages. Preliminary determinations of the ^{129}I/^{129}Xe ratios in two tellurium ores were carried out, but no conclusive results were obtained for the origin of excess ^{129}Xe in tellurium ores. (auth) (INIS)

50574 BIOGEOCHEMICAL PROSPECTING FOR URANIUM DEPOSITS. Kovalevskii, A. L. At. Energ. (USSR); 33: No. 1, 557-62(Jul 1972). (In Russian).

The results obtained earlier on the low efficiency of biogeochemical prospecting for uranium deposits when the uranium in plants was used as a biogeochemical indicator can be explained as due to physiological barriers to high concentrations of uranium. Such barriers have been observed in the case of 34 chemical elements, which can be divided into four groups: barrier at Clarke soil concentrations; barrier at somewhat higher concentrations (3 to 30 times higher); barrier at very high natural concentrations (30 to 300 times higher than Clarke concentrations); and no barrier at such very high concentrations. The high geological effectiveness of biogeochemical prospecting based on radium in plants can be explained by the fact that radium belongs to the fourth group ("no barrier" chemical elements). It is proposed to use radium as the main indicator of uranium mineralization, and as supplementary indicators uranium and 12 non-radioactive elements (Pb, Mo, As, Ag, Zn, Cd, Cu, Bi, Ni, Co, Se, and V), the distribution of which is determined by the type of uranium mineralization. Recommendations are presented on plant testing a rational complex of plant sampling, and investigation, and interpretation of obtained data. Factors determining the effectiveness of biogeochemical prospecting for uranium deposits based on radium in plants and also the conditions and regions of practical application are considered. Means of improving biogeochemical prospecting for uranium deposits by means of auto- and aerial-biogeochemical methods, and mechanization and automation of labor-consuming operations are also considered. (auth)

50575 CARBON ISOTOPIC COMPOSITION OF COLORED VARIETIES OF YAKUTIAN DIAMONDS. Koval'skii, V. V.; Galimov, E. M.; Prokhorov, V. S. Dokl. Akad. Nauk SSSR; 203: No. 2, 440-2(11 Mar 1972). (In Russian).

Twelve samples of colored diamonds from Yakutia were subjected to isotopic analysis in a mass spectrometer. These samples were characterized by a range of $\delta^{13}C$ values from -0.50 to -3.23%, where $\delta^{13}C = (^{13}C/^{12}C/1{,}123.72) - 1$, signifying that a number of samples were enriched in the isotope ^{13}C, as compared with the carbon isotope values usually encountered. In order to account for this phenomenon, it is suggested that colorless and colored diamonds had originally crystallized under different conditions. (K.S.W.)

50576 MONAZITE. Ward, J. Aust. Miner. Ind.; 199-201 (1971).

The Australian production of monazite concentrates amounted to 4,367 tons in 1970 (monazite content 3,929 tons). Production could be almost doubled if warranted by world demand. Exports of monazite concentrates averaged $137 per ton f.o.b. (Australia)

50577 KINETICS OF THE MIGRATION OF ATOMS OF RADIOGENIC LEAD IN URANITE. Magomedov, Sh. A. Sov. Radiochem. (Engl. Transl.); 14: No. 1, 111-14(1972).

Translated from Radiokhimiya; 14: No. 1, 114-18(1972).

Results of vacuum sublimation and leaching investigations showed that lead exists in uranite (Northern Karelia) in two positions: unstable (surface zone) and stable (volume zone). The values of the diffusion coefficients and the activation energies of lead isotopes in the surface and volume zones were obtained experimentally. The ability of nitric acid solutions to leach out lead isotopes was studied. A change in the rate of passage of lead from the mineral into the solution with time was shown. (auth)

50578 URANIUM. de Ferranti, R. Z. Aust. Miner. Ind.; 297-302(1971).

Aspects of uranium exploration, discovery, trade, and utilization in Australia during 1970 are reviewed. Exploration in Queensland, South Australia and the Northern Territory is described. Australian uranium reserves in mid 1970 are estimated: Recoverable at less than $US10/lb U_3O_8, Reasonably assured—21,700 short tons U_3O_8, Estimated additional—6,700 short tons U_3O_8; Recoverable at $US10–15/lb U_3O_8, Reasonably assured—9,200 short tons U_3O_8, Estimated additional—6,600 short tons U_3O_8. A brief review of world UO_2 production from 1967–1970 is made. (Australia)

50579 URANIUM IN AUSTRALIA. Stewart, J. Ross. Com. Naz. Energ. Nucl., Notiz.; 17: No. 12, 47-52(Dec 1971). (In Italian).

The history of uranium prospecting in Australia since 1947 is reviewed. Information on the picture of the country's main ore deposits is presented. (auth)

50580 NON-DISPERSIVE X-RAY FLUORESCENCE METHOD USING TWO X-RAY SOURCES FOR THE DETERMINATION OF GRAIN SIZE AND CONCENTRATION OF THE MAJOR ELEMENT IN SIMULATED ORE SLURRIES. Holynska, B. (Academy of Mining and Metallurgy, Krakow). Spectrochim. Acta, Part B; 27: No. 7, 287-94(Jul 1972).

A non-dispersive x-ray fluorescence method using two x-ray sources for determination of grain size and concentration of the major element in aqueous slurries is described. Magnetite was chosen as a mineral to be determined. The nomographic method of presentation of the results is used. Both theoretical and experimental results are shown, the latter being based on measurements using simulated aqueous slurries. There is no full quantitative agreement between theoretical and experimental nomographs. The influence of matrix composition was also studied. It was found that grain size determination is only slightly influenced by matrix variation. (auth)

50581 ADVANCES IN PROSPECTING FOR URANIUM. Hahn-Weinheimer, P. (Technische Univ., Munich). Kerntechnik; 14: No. 6, 249-53(Jun 1972). (In German and English).

The prospecting for low-grade uranium ores is necessary for obtaining the raw material for the increasing nuclear energy generation. That requires the use of specific geophysical prospecting methods with efficient appliances like gamma spectrometers, alpha detectors and others, for measurement of radioactivity from the air, in the field, and in the borehole. In case that geophysical measurements are impossible, geochemical analytical methods for traces of uranium in rivers, lakes, plants, and soil are applied. Tracer elements can be a hint for uranium contents as far as satisfactory analytical methods are at hand. (auth)

Radioactive Effluents

Refer also to abstracts 50261, 50317, 52480, 52519, and 52543.

50582 (INIS-mf-115, pp 71-6) MAINTENANCE OF THE QUALITY OF THE ENVIRONMENT. Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1971. INIS.

The problems of pollution of the human environment arising out of the development of industries in the country are surveyed. Lack of proper understanding of the essential need to ensure a clean environment in the industrial areas is pointed out. The need to attribute a quantitative notion to the quality of an environment is stressed. It is to be noted with satisfaction that, in the case of atomic energy industries, very strict measures have been adopted to afford radiation protection and a clean environment to the population in and around the areas. Establishment of a national committee for clean environmental quality specifications and enforcement is considered to be an essential requirement as a guiding force in the country. (INIS)

50583 (IRS-W-1) DISCHARGES OF RADIOACTIVE MATERIAL WITH NORMAL PERFORMANCE OF LIGHT WATER REACTORS IN THE BRD. Herrmann, G. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Mar 1972. 79p. (In German). Dep. NTIS (U. S. Sales Only).

Data on radioactivity in and radioactive discharges from nuclear power stations with light water reactors have been collected. The design values have been taken from safety reports (four boiling and pressurized water reactors each are represented) for which data are given. Discharges have also been evaluated for operating reactors. These data are also included. (auth)

50584 (TID-25857, pp 87-91) PROPOSAL FOR A RATIONAL POLICY TO CONTROL RADIOACTIVITY AND OTHER FORMS OF POLLUTION. Tamplin, Arthur R. (Univ. of California, Livermore). 1972.

In Environmental and ecological forum, 1970-1971.

A recommendation is given for pollution control whether it is industrial or nuclear. The recommendation as given states that to properly protect the public health and safety, the laws should read that the acceptable limit of pollution is zero and that the privilege of releasing a pollutant to the environment must be negotiated. The prospective polluter should be required to demonstrate in a meaningful manner that his activity will produce benefits to those affected that outweigh the risk. The burden of proof should be shifted from the public and/or government regulatory agency to the polluter. The polluter must be made responsible for convincing the public that he has done everything possible to reduce the level of pollution and that the benefits to be derived from his activity outweigh the risk of the remaining pollution. (P.C.H.)

50585 RESPIRABLE FRACTION OF PLUTONIUM AT ROCKY FLATS. Volchok, H. L. (New York Operations Office, N. Y.); Knuth, R. H.; Kleinman, M. T. Health Phys.; 23: No. 3, 395-6 (Sep 1972).

As part of the investigations undertaken by the Health and Safety Laboratory of the U. S. Atomic Energy Commission into the health hazards to which the people in the Denver area might be exposed, due to the operation of the Rocky Flats Plant, an evaluation was made of the part of the airborne plutonium bearing dust which is respirable. Both a horizontal elutriator and a cyclone were used to remove all but the respirable fraction of the dust and this was retained on back-up filter papers. Details of sampling site positions and wind velocities encountered are given. The highest values were obtained 1½ miles due east of the plant where a concentration of 19 fCi/m^3 was obtained which is >30% of the MPC for soluble Pu with bone as the critical organ. (UK)

50586 TREATMENT, DISPOSAL, AND DISCHARGE TO ENVIRONMENT OF RADIOACTIVE WASTES. Nomi, Mitsuhiko (First Atomic Power Industry Group, Tokyo). FAPIG (Tokyo); No. 63, 136-42(Nov 1971). (In Japanese).

The quantity of gaseous and liquid radioactive wastes released by nuclear power stations in England, Germany, and the USA are shown. Heretofore, it has been recommended that any such dose must be kept as low as practicable. But this report numerically prescribes both the released quantity and released concentration of the radioactive materials. According to this prescription, the maximum permissible dose to the population is to be lowered significantly. It proposes that the exposure dose to the inhabitants in neighborhood of plants should not exceed 5% of the yearly mean natural radiation dose. This proposed dose (5 mR/y) seems to be 1% of the federal radiation protection standard or less. Heretofore, the released quantity of radioactive materials has been decided with reference to recommendation of the International Commission of Radiological Protection. Now and in the future, the restriction on the radiation release will be much more strict. (Japan)

50587 SAFETY STANDARDS: PRINCIPLES AND PRACTICE. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.); Preston, A. Int. At. Energy Agency Bull.; 14: No. 2, 19-25(1972).

A summary of methods used in the UK to control releases of radioactive materials is presented. Information is included on dose limits, waste management, and principal fission product wastes. (J.R.D.)

Radioactivity Transport and Monitoring

Refer also to abstracts 50206 and 50767.

50588 (BNWL-1651(Pt.2)) ANNUAL REPORT FOR 1971 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 2. RADIOLOGICAL SCIENCES. Nielsen, J. M.; (and others) (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. Contract AT(45-1)-1830. 117p. Dep. NTIS.

Brief summaries are presented of work done in the fields of environmental and radiological chemistry, radiation instrumentation, radiation dosimetry, and radiation and health physics. Eighteen separate abstracts were prepared. (D.L.C.)

For abstracts of individual sections see: 50205, 50206, 50215, 50323, 50597-50599, 50607, 50608, 50613-50615, 50969-50971, 50981, 52207, and 52208.

50589 (COO-1515-41) TECHNICAL PROGRESS REPORT. Jackson, Marion L. (Wisconsin Univ., Madison. Dept. of Soil Science). 26 Apr 1972. Contract AT(11-1)-1515. 20p. Dep. NTIS.

Research progress is reported on osmotic swelling in micaceous vermiculite basal cleavages, adsorption of cations by hydrous metal oxides, structural configurations of micaceous vermiculites, and aerosolic dusts in the trophosphere containing radiocesium and radiostrontium. (J.R.D.)

50590 (IS-2926) SURVEY OF ENVIRONMENTAL RADIOACTIVITY, JANUARY 1, 1972-JUNE 30 1972. Voss, Milo D. (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 22p. Dep. NTIS.

The environmental program for the Ames Laboratory Research Reactor (ALRR) consisted of gross alpha and beta determinations in air samples, soil, vegetation, river water, bottom sediment, precipitation, pond water, ALRR outfall, and well water samples. The ALRR reached full power as of 7/12/65. As of 12/31/71 the ALRR had generated 170110 megawatt hours of heat. A total of 187146 megawatt hours of heat was generated as of 6/30/72. The data indicated that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area. The conclusion is reached that radioactivity levels recorded for environmental samples represent background conditions from atmospheric fallout and naturally occurring radioactivity. (auth)

50591 (NP-19362) FIELD STUDIES ON PERIPHYTON, APRIL 1970-MARCH 1971. Delinck, H. J.; Lamble, M. O.; Czerwinski, James L. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 12 Dec 1971. 44p.

Data are presented on the periphyton species found on permanent substrates from off the southwest shore of Lake Michigan in a region from North Chicago to the Illinois-Wisconsin border. The sampling and analysis methods are described. (L.C.L.)

50592 SIZE SELECTIVE SAMPLING FOR ^{238}Pu. Ettinger, Harry J.; Moss, William D.; Johnson, Lamar J. (Los Alamos Scientific Lab., N. Mex.). Health Phys.; 23: No. 1, 41-6(Jul 1972).

While most air sampling for plutonium measures total airborne activity, evaluation of potential lung deposition requires an estimate of the activity undergoing long-term retention. Maximum Permissible Concentrations (MPC) defined by the ICRP include a factor to correct for an assumed long-term retention component. In order to evaluate more accurately potential lung deposition for workers in ^{238}Pu glovebox areas a program was initiated to measure the respirable activity, using two-stage (cyclone-filter) samplers. Detailed plutonium size characteristics were also estimated by using nuclear track techniques. Sampling results indicated that the respirable fraction generally ranges from 0.75 to 1.00, considerably greater than that assumed by the ICRP when defining MPC levels. Nuclear track analysis showed that most plutonium activity is due to a relatively small number of 0.2 to 1.0 μm particles. Only 25% of paired adjacent air samplers defined air concentrations within 50% of each other. The data suggest that area air samplers may incorrectly estimate potential lung deposition to individual workers. (auth)

50593 COLLECTION OF UNATTACHED RaA ATOMS USING A WIRE GAUZE. James, A. C.; Bradford, G. F.; Howell, D. M. (National Radiological Protection Board, Sutton, Eng.). J. Aerosol Sci.; 3: No. 4, 243-54(Jul 1972).

A 200 mesh wire gauze was found to collect airborne unattached RaA with an efficiency of more than 98%, at an air-sampling rate of 10 l/min through an area of 14 cm^2. Collection of RaA attached to condensation nuclei having a diffusivity of 10^{-5} cm^2/sec was estimated to be of the order of one per cent. The α-activity collected on the gauze could be counted with the same efficiency as that for attached material collected on a back-up filter, when the airborne activity was sampled at 10 l/min. A simple "cylindrical diffusion tube" model adequately represented the collection of free RaA atoms on the wires of the gauze. (auth)

50594 MEASUREMENT OF THE UNCOMBINED FRACTION OF RADON DAUGHTERS WITH WIRE SCREENS. George, A. C. (USAEC New York Operations Office, N. Y.). Health Phys.; 23: No. 3, 390-2(Sep 1972).

An investigation was carried out into the efficiency of wire screens to collect the uncombined fraction of radon daughters in an attempt to simplify apparatus for use in uranium mines. It was found by measuring screen collection efficiency for condensation nuclei with which radon daughters combine that a reasonable efficiency may be obtained by a proper combination of mesh size and air velocity. The results are tabulated and from these it is seen that with a 60 mesh screen the collection efficiency of RaA atoms at a flow rate of 11 to 5 cm/sec was 77% in very close agreement with previous theoretical work. Further experimental work with this size mesh confirmed that this screen can be substituted for the diffusion sampler normally used. (UK)

50595 NUCLEAR ENERGY AND THE ENVIRONMENT. Seaborg, Glenn T. (Univ. of California, Berkeley). Int. At. Energy Agency Bull.; 14: No. 2, 2-11(1972).

Aspects of the interplay between the use of nuclear energy for electricity generation and the need to protect the environment are discussed. Topics included in the discussion are population numerical stability, reactor safety, reactor efficiency, power consumption, and waste disposal. (J.R.D.)

50596 ECOLOGICAL ASPECTS OF RADIATION PROTECTION. Recht, P. (Commission of European Communities, Brussels. Free Univ., Brussels). Int. At. Energy Agency Bull.; 14: No. 2, 26-32(1972).

Aspects of nuclear power expansion, particularly in the European countries, are discussed. It is noted that the future of power programs based on the use of nuclear stations may depend on finding methods of protecting human health and environment. Discussions are included on ecology inventory and analysis, and on uncontrolled releases. (J.R.D.)

Atmosphere

Refer also to abstracts 50205, 50744, and 50974.

50597 (BNWL–1651(Pt.2), pp 29-32) IN-CLOUD SCAVENGING. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

Several inert tracers were released into precipitating clouds near Quillayute, Wash. and St. Louis, Mo. in order to determine precipitatation scavenging efficiencies and aerosol and hydrometeor trajectories. Rain samples obtained from networks of rain collectors are being analyzed for the tracer materials by neutron activation techniques. Concentrations of the cosmogenic radionuclides ^{24}Na, ^{38}Cl, and ^{39}Co were measured in large volume rain samples to determine scavenging efficiencies and elapsed times between scavenging and arrival of the precipitation at the ground. The concentrations of these cosmogenic radionuclides in argon and in air filter samples are also being measured to determine atmospheric production rates. (auth)

50598 (BNWL–1651(Pt.2), pp 38-46) RADIOACTIVE FALLOUT RATES AND MECHANISMS. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The concentrations of trace elements, cosmogenic radionuclides, and nuclear-weapons-produced radionuclides were measured in the air from ground level to 19 km and in rain and seawater in order to determine the origin and chemistry of the atmospheric aerosols and to study the rates of atmospheric and oceanic mixing, the rates of air-sea interchange, and the rates and mechanisms of precipitation scavenging. (auth)

50599 (BNWL–1651(Pt.2), pp 69-73) TRACER STUDIES IN THE METROMEX EXPERIMENT. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The central objective of the METROMEX project is to study convective storms in the St. Louis metropolitan area. During August of 1971 Battelle-Northwest personnel released ruthenium, selenium and gold tracers into the updrafts of convective storms from a ground-based aerosol generator. Samples of rain from these storms, collected using a network of over 100 samplers, are being analyzed for these tracers by neutron activation to determine aerosol scavenging efficiencies and aerosol and hydrometeor trajectories. Large volume rain samples were analyzed for the short-lived cosmogenic radionuclides ^{24}Na, ^{38}Cl, and ^{39}Cl in order to determine aerosol scavenging efficiencies and the elapsed times between scavenging and the arrival of the precipitation at ground level. Air filter samples collected from ground level to 45,000 feet both upwind and downwind of St. Louis are being analyzed to determine the amounts of contaminating materials added to the atmosphere by the St. Louis metropolitan area. (auth)

50600 (COO–578-18) SCAVENGING STUDY OF SNOW AND ICE CRYSTALS. Quarterly Progress Report, November 1, 1971–January 31, 1972. Sood, Sudesh K. (IIT Research Inst., Chicago, Ill.). Feb 1972. Contract AT(11-1)-578. 29p. (IITRI-C–6105-18). Dep. NTIS.

A new aerosol scavenging test chamber, 1.3 × 1.3 × 3 m, was assembled, and fitted with the anthracene aerosol generator and sampling equipment. Initially, some problems in sampling anthracene aerosols outdoors were encountered. These sampling problems have been resolved, and snow scavenging experiments are now proceeding satisfactorily. An evaluation of the experimental data on the collection efficiency of raindrops for small aerosol particles is presented. (auth)

50601 (IITRI-C–6105-19) SCAVENGING STUDY OF SNOW AND ICE CRYSTALS. Final Technical Report, April 1, 1971–March 31, 1972. Sood, Sudesh K.; Knutson, Earl O. (IIT Research Inst., Chicago, Ill.). Mar 1972. Contract AT(11-1)-578. 75p. Dep. NTIS.

A method was developed for generating fluorescent, solid particle aerosols of anthracene by means of condensation on sodium chloride nuclei. The apparatus is convenient to operate and produces a reasonably monodisperse aerosol. The median particle diameter may be varied from 0.25 to 2.5 μ. Five outdoor tests were done to determine the scavenging efficiency of natural snow and ice crystals for the anthracene aerosols. The scavenging efficiency was determined by direct counting of the number of particles caught by individual crystals, using ultraviolet microscopy. The particle dia in these tests ranged from 0.29 to 0.65 μ. A pronounced minimum was found in the scavenging efficiency versus particle size curve. The minimum value is 0.03% at 0.4 μ-dia. The scavenging efficiency was found to be independent of crystal habit. (auth)

50602 RADIOACTIVE FALLOUT IN DENMARK IN 1967 AND 1968. Ennow, Klaus. Fra Sundhedsstyr.; 5: 220-3(Aug 1970). (In Danish).

The fallout measured in the air and precipitations and the ^{90}Sr, ^{137}Cs, and ^{14}C measured in milk and grain products is tabulated and graphed. (J.S.R.)

50603 SAMPLING SYSTEM FOR TRITIUM OXIDE AND ^{14}C IN ENVIRONMENTAL AIR. Cantelow, H. P.; Boltin, R. L.; Peck, J. S.; Aune, R. G. (Univ. of California, Berkeley). Health Phys.; 23: No. 3, 384-5(Sep 1972).

Details are given of the air mover, flow regulator, tritium sampler and ^{14}C(CO$_2$) sampler which together constitute the sampling system. The routine sampling period is one week at a flow rate of 10 cm^3/min giving a total sample volume of 0.1 m^3 and a sample of 30 cm^3 of CO$_2$ deposited in the bubbler solution. The counting techniques are outlined. The sensitivity obtainable for the tritium content with a 20 min counting time is about 1nCi/m^3 (1% of the nonoccupational MPC). For the ^{14}C the limit of sensitivity is about 20 pCi/m^3. Errors and collection efficiencies are discussed. (UK)

Soil

Refer also to abstract 50990.

50604 (EGG–1183-1558) AERIAL RADIOLOGICAL MEASURING SYSTEM PROGRAM. Doyle, J. F. (EG and G, Inc., Las Vegas, Nev.). 1972. 33p. (CONF-720805–4). Dep. NTIS.

From 2nd conference on natural radiation environment; Houston, TX. (7 Aug 1972).

The operation of the Aerial Radiological Measuring System (ARMS) which consists of an aircraft carrying a radiation measuring system that includes a detector array, channel analyzers, computers, digital display and recording equipment, etc. is described and experience in its use for routine and emergency missions is discussed. It is concluded that ARMS has demonstrated how state-of-the-art research and technology can be applied to practical situations and that aerial survey systems would be invaluable to the nuclear safety program should there be an emergency. ARMS is expected to play its most active nuclear safety role through routine surveillance of areas which include nuclear facilities. Research to develop further refinements in the system is recommended. (L.C.L.)

50605 (EGG–1183-1559) TECHNICAL PROCEDURES FOR CHARACTERIZING THE TERRESTRIAL GAMMA RADIATION ENVIRONMENT BY AERIAL SURVEYS. Burson, Z. G.; Boyns, P. K.; Fritzsche, A. E. (EG and G, Inc., Las Vegas, Nev.). 1972. 44p. (CONF-720805–3). Dep. NTIS.

From 2nd conference on natural radiation environment; Houston, TX. (7 Aug 1972).

Technical procedures and considerations for interpreting the results of the surveys of the Aerial Radiological Measuring System (ARMS) and converting airborne nuclear counting data to terrestrial, surface exposure rates, and isotopic concentrations are discussed. Some of the important considerations include: background delineations, ground roughness and source distribution effects on the air-to-ground conversions, the treatment of the data to obtain ground-level information, validating the results by correlating with ground-level experimental data, and the use of spectral information for isotope identification. (auth)

50606 (RFP-Trans–103) PRACTICAL USE OF THE DISTRIBUTION COEFFICIENT FOR MEASUREMENT OF RADIOACTIVE CONTAMINATION OF MINERALS IN ROCKS, SOIL, AND UNDERGROUND WATERS. Ranzon, Daniel (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Translated for Dow Chemical Co., Golden, Colo., from report CEA-R–4274. 33p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 26: 31015.

Water

50607 (BNWL–1651(Pt.2), pp 18-25) PHYSICAL AND RADIOLOGICAL CHEMISTRY OF OCEAN SOLUTIONS. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The rates and mechanisms of the chemical and mixing processes in the ocean were investigated by use of the ocean's natural elemental and radionuclide tracers. These studies, as a function of depth over wide areas of the ocean, are allowing the determination of factors governing vertical diffusion and the determination of oceanographic pollutant concentrations and their pathways to man. (auth)

50608 (BNWL–1651(Pt.2), pp 26-8) GEOCHEMICAL OCEAN SECTIONS STUDY (GEOSECS). (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The multi-institutional GEOSECS program is designed to measure a large group of ocean constituents and hydrographic parameters during transects of the world's major oceans, with the aim of better understanding the geochemistry and mixing dynamics of the oceans. Two preliminary intercalibration and testing cruises, one in the N.E. Pacific and another in the N.W. Atlantic, have been completed in preparation for the main GEOSECS expeditions which will begin this summer in the N. W. Atlantic Ocean. Battelle-Northwest has participated in both of these intercalibration cruises, measuring trace element, ^{7}Be and fallout radionuclide concentrations in depth profiles. During the GEOSECS program these measurements will help characterize the ocean's geochemistry, determine the worldwide oceanic deposition of radionuclides and define the vertical mixing rates above, through and below the main thermocline. The results of these preliminary studies of trace element and radionuclide measurements are summarized. (auth)

50609 (BNWL-SA–4330) SPECIFIC ACTIVITY OF RADIONUCLIDES SORBED BY MARINE SEDIMENTS. Duursma, E. K. (International Lab. of Marine Radioactivity, Monaco); Rancitelli, L. A.; Robertson, D. E. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. 20p. (CONF-720708–5). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

Studies were made on whether the binding of radionuclides to sediments in a waste disposal area can be predicted from studies of the trace metal contents of the sediments. To evaluate this, the experimentally determined distribution coefficients of various radionuclides and the existing corresponding stable isotope distribution were compared for different marine sediments. The ratio of the distribution coefficient of the radionuclide to that of its stable counterpart was considered to be a measure of the amount of the stable isotopes available for exchange with radionuclides in seawater. The ratios were normally low but ranging from about 0.1 to 100% for the different elements and sediments tested. The practical application for waste disposal evaluations is that the ratios estimated for a particular area might be used for a first approximation of the maximum amount of radionuclides that might be held by the sediment at a given specific activity in the seawater. (auth)

50610 (INIS-mf–160, pp 164-91) AQUATIC POLLUTION CONTROL SYSTEMATICS FOR DISCHARGE OF RADIOACTIVE EFFLUENTS. Pillai, K. C. (Bhabha Atomic Research Centre, Bombay (India)). 1971. (CONF-700847–4). INIS.

From Seminar on pollution and human environment; New Delhi, India (26 Aug 1970).

Systematic study of radioactive pollution control for environmental discharge of low-level liquid effluents from the Bhabha Atomic Research Center, Trombay, was started in 1957 and the observation and results of these studies are reported. Dilution mechanisms in the west coast of Bombay harbor bay on which the Trombay Establishment is situated, were studied. ^{24}Na and ^{42}K were used as tracers and the activity was traced by in situ measurements, using underwater gamma probes at different locations and then, by measuring the gamma activity in the laboratory. The diffusion of tracer discharged, possible concentration of radionuclides in fish harvested from the bay and salt produced from the bay waters, were studied. The maximum permissible concentration of radionuclides in seawaters, average consumption rate for fish and the concentration of stable elements in seawater, salt, and fish were evaluated on the basis of recommendations of ICRP for dose limits for population. The results of these studies revealed that the safety levels were never exceeded in any case. Higher concentration of some radionuclides was noticed in silt and bottom sediments, but radioactive exposures from such sources were negligible. At Ranapratap sagar, the evaluation of acceptable limits for freshwater was made on the basis of data collected from preliminary studies at sites. The operation for control of waste release into the Chambal River were guides by the above limits. But these are liable to be altered when further data is available on the environment. Values of permissible limits for radionuclides in salt, sea fish and seawater are given. (INIS)

50611 (USGS–474-159) RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT, AMCHITKA ISLAND, ALASKA, JANUARY 13–APRIL 5, 1972. Amchitka-35. Schroder, L. J.; Ballance, Wilbur C. (Geological Survey, Denver, Colo.). 1972. Contract AT(29-2)-474. 19p. Dep. NTIS.

The U.S. Geological Survey collected 110 water samples from Amchitka Island, Alaska, between January 13 and April 5, 1972. Tritium determinations were made on all samples collected and gross alpha and gross beta/gamma determinations were made on 92 samples. The gross alpha and gross beta determinations when compared with previously determined ranges for fresh waters on Amchitka Island show no trends. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 50847, 50919, 50963, 50964, 50973, 50982, 50984, and 50985.

50612 (BMI–171-203) TRITIUM AND ITS EFFECTS IN THE ENVIRONMENT: A SELECTED LITERATURE SURVEY. Rudolph, A. W.; Carroll, T. E.; Davidson, R. S. (comps.) (Battelle Columbus Labs., Ohio). 30 Jun 1971. Contract AT(26-1)-171. 378p. Dep. NTIS.

Approximately 600 references with abstracts on tritium and its effects in the environment with emphasis on man are given to reports, conferences, and journals published from 1957 through 1971. Separate subject, author, and report number indexes are included. (P.C.H.)

50613 (BNWL–1651(Pt.2), pp 8-17) RATES OF DEPOSITION OF AIRBORNE RADIONUCLIDES IN THE ALASKAN ENVIRONMENT. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The atmospheric deposition rates, routes, biological uptake rates and concentrations of fallout radionuclides and their stable element counterparts are being investigated in the terrestrial and marine environments, with emphasis on the food chains that consistently lead to high radionuclide concentrations. (auth)

50614 (BNWL–1651(Pt.2), pp 47-9) ^{55}Fe AND LEAD IN THE HUMAN POPULATION OF THE WORLD. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

This study investigates the transfer of ^{55}Fe from fallout, with special emphasis on the concentrations in man and in food chains leading to human consumption. Transfer is being measured in the general population as a function of age, sex, and diet, including the dilution effect of stable iron. Although ^{55}Fe is being emphasized, the same samples are used to measure Pb, ^{210}Pb, and ^{210}Po in the biosphere. (auth)

50615 (BNWL–1651(Pt.2), pp 74-80) RADIONUCLIDE DECLINE IN COLUMBIA RIVER WATER. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The radionuclide depletion processes in the Columbia River are being characterized following the closure of the Hanford reactors. Residual radioactivity is associated mainly with sedimentary deposits behind McNary Dam. The most abundant radionuclides are ^{55}Fe, ^{65}Zn, ^{46}Sc, ^{155}Eu, ^{60}Co, ^{152}Eu and ^{154}Eu. These radionuclides are bound to the sediments and enter the river by sediment resuspension and dissolution into soluble forms. The main mechanism for depletion of radioactivity from the river, other than radioactive decay, is by scouring of surface sediments during high river flow, and their subsequent transport into the Pacific Ocean. It appears that eventually the radioactive sediment deposits behind McNary Dam will become covered by new, uncontaminated silt deposits. The high fraction of radionuclides in the particulate form in Columbia River water changes their availability for biological uptake. (auth)

50616 (TID–25857, pp 1-50) MAN'S CONQUEST OF ENERGY: ITS ECOLOGICAL AND HUMAN CONSEQUENCES. Hubbert, M. King (Geological Survey, Washington, D. C.). 1972.

In Environmental and ecological forum, 1970–1971.

Man's progressive conquest of energy during the last million years and its consequences to the earth's plant and animal ecology and in particular to man himself is discussed. The topics included are: terrestrial energy flux; future of production of energy from fossil fuels; fossil fuels in historical perspective; other sources of industrial energy; industrial metals; principles of ecology; and human affairs in time perspective. (P.C.H.)

Radiometric Techniques

Refer also to abstract 50214.

50617 (CEA-CONF–1982) OPTIMIZATION OF SAMPLING FOR DETERMINATION OF THE WATER BALANCE IN CULTIVATED LAND BY MEANS OF A NEUTRON MOISTURE GAGE. Peyremorte, P.; Philippeau, G. (Institut Technique des Cereales et Fourrages, Paris (France)); Marcesse, J. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). [nd]. 18p. (In French). (CONF-711213–2). Dep. NTIS (U. S. Sales Only).

From Symposium on the use of isotopes and radiation in research on soil-plant relationships including applications in forestry; Vienna, Austria (13 Dec 1971).

The use of the neutron moisture gage appears to be, for agronomy, the best method for determining water balances. Advantages accruing to this method include reproducibility and direct measurement. However, generalization to a surface of values obtained from point measurements requires consideration of the problems of sampling and account taken of the scale of the measurements and the degree of precision required. A study is reported of the conditions for the in situ determination, by means of a neutron moisture gage, water balances representative of a surface of several m^2. The object of the study was to define the characteristics of effective sampling, on the one hand assuring representative results and on the other hand limiting the time necessary for obtaining the information. It was found that the error attributable to the neutron measurement is negligible in comparison with that arising from the heterogeneity of the medium. In order to have a precision of ± 10 mm (at the 95% confidence level), for instance, it was shown that one must analyze at least 12 casings implanted vertically and 3 implanted horizontally. One solution consists of emplacing horizontal casings (three, for example) in which one can make as many measurements as necessary. This maintains the natural conditions of the land, an additional guarantee that the points analyzed are representative, and decreases the time required by more than 50%. When emplacement trenches are dug, it is convenient to evaluate the resulting perturbation in each case. Under these conditions one can use rather long tubes crossing several experimental parcels or implanted in land cultivated at low density, such as with vines or fruit trees. (R.W.R.)

50618 (INIS-mf–271) METHODS FOR PRACTICAL DETERMINATION OF THE FLOW RATE OF GROUND WATER. PART 3. FIELD INVESTIGATIONS AT GAARDSRYD. Carlsson, Leif (Chalmers Tekniska Hogskola, Goteborg (Sweden)). [nd]. 229p. (In Swedish). INIS.

The rate of ground water flow was studied in order to compare different methods for determination of the flow rate. A combined tracer and pump experiment was performed in a sand and gravel deposit. HTO and ^{51}Cr-EDTA were used as tracers. At the place of investigation, 24 observation pipes were set in the ground. A sample place was arranged consisting of five pumping pipes and one pump. Bulk densities and proportions of water in the different pipes were measured by gamma–neutron probe. The tracers were injected 23 m from the center of the sampling place. They were followed by detection of ^{51}Cr-EDTA in observation pipes on their way to the sampling place. At the same time the ground water level was registered. Water samples for laboratory determination of tritium and ^{51}Cr activity were taken. Results show a great dispersion of the tracers and a delay of ^{51}Cr-EDTA compared with HTO. Penetration of water and storage coefficients were calculated by five different methods for non-stationary states. Comparisons between different positions from both tracer experiments and calculations at non-stationary states were made. (INIS)

50619 (INIS-mf–272) STUDIES OF GROUND-WATER FLOW IN VARIOUS AQUIFERS USING TRACERS. Knutson, G. (Lund Univ. (Sweden)). [nd]. 20p. INIS.

A summary is given of results earlier published of the investigations of ground water flow in various aquifers using tracers. Additional studies of water movement in organic soils and in Karst soils as well as the results of the laboratory experiments are presented. ^{51}Cr-EDTA, HTO and ^{82}Br(in NH_4Br) were used as tracers. (INIS)

50620 ASSESSMENT OF ERROR LIMITS IN THERMOLUMINESCENT DATING. Aitken, M. J.; Alldred, J. C. (Oxford Univ.). Archaeometry; 14: No. 2, 257-67(Aug 1972).

Sources of error, both random and systematic, are discussed; quantitative limits are suggested; and a consistent method is proposed for compounding them to yield an overall error in age, both for individual sherds and for the weighted average of a number of sherds from the same context. It is proposed that two error limits should be quoted for the date of a context: first, the standard error of the mean value as calculated from the experimentally observed root-mean-square deviation of the individual samples, and secondly, the expected overall error from the sources discussed in the paper. The former can be considered as a lower limit and relevant when comparing contexts on the same or similar sites whereas the latter is more realistic when comparing TL dates with radiocarbon or archaeological chronology. (auth)

50621 RADIOCARBON DATING BY THERMOLUMINESCENT DOSIMETRY. Winter, J. (Univ. of Pennsylvania, Philadelphia). Archaeometry; 14: No. 2, 281-6(Aug 1972).

Work is presented that tests the possibility of performing radiocarbon dating measurements by using the thermoluminescence induced in sensitive phosphors, using existing thermoluminescence equipment. It is concluded that, for such a technique to be viable, a more specifically designed and more elaborate system will be necessary. Some comparative results on certain TLD phosphors are also given. (auth)

50622 DIFFUSIBILITY OF PHOSPHATE IONS IN SOIL. Barbier, G.; Fardeau, J. C.; Marini, P. (CEN de Cadarache, Saint-Paul-les-Durance, France). Ann. Agron.; 22: No. 3, 309-42(1971). (In French).

The self-diffusion of phosphate ions accumulated in soil through fertilizer residue during previous decades was investigated. The errors in interpretation resulting from the application of the isotopic dilution formula to groups of phosphorus atoms (soil, or soil + plant) whose isotopic compositions are nonuniform are examined. The validity of isotopic measurement technique was confirmed from results obtained when the isotopic tracers of two phosphorus sources were interchanged. Studies of soil samples obtained from fields which have been under cultivation for a long period of time confirmed that a considerable fraction of the long-buried phosphate ions were no longer isotopically exchangeable (in a period compatible with that of ^{32}P.). At the isotopic dilution limit, the ratio representing the increase in isotopically exchangeable PO_4 and the total mineral PO_4 did not exceed 10% in the calcareous soils studied. Even in soils, which are neither calcareous, nor distinctly acid, this ratio can exceed 50%. Nevertheless, it is premature to conclude that the maintenance of the present level of PO_4 ion chemical activity requires phosphorus enrichment of the soil over an indefinite period of time. It was demonstrated that plant roots have the ability to liberate PO_4 from solid organic or mineral compounds, especially from calcium based compounds. An apatitic phosphate from Gafsa was found to be attacked by rye-grass even in basic soil, but not in calcareous soil. An experiment on plant phosphorus nutrition in a heterogeneous environment is discussed, the concentration of diffusible phosphorus being investigated. (France)

50623 METHOD OF STUDYING THE FORMATIONS PENETRATED BY A DRILLING USING NEUTRONS. Nelligan, William B. (to Societe de Prospection Electrique Schlumberger). French Patent 1,604,351. 8 Nov 1971. Filed 9 Apr 1968. (In French).

A method is described for determining the characteristics of an unknown material by neutron irradiation during a given time interval. Measurement of the rate of change of the neutron concentration in the material is effected at a given time after the irradiation, the time interval depending on the time constant of the neutrons in the material. The apparatus used to study the ground surrounding drilling sites is described. This apparatus consists of a neutron source, radiation detectors, and circuits for calculating the rate of change of the neutron concentration. A means of controlling the time interval between the operation of the neutron source and the operation of the counting circuits is provided. (France)

Site Surveys

Refer also to abstract 52427.

50624 (DOCKET-50201-129) WEST VALLEY REPROCESSING PLANT. Tornado Wind Damage Probability and Recurrence. (Nuclear Fuel Services, Inc., Rockville, Md.). 17 Aug 1972. 52p. Dep. NTIS.

Information is presented on tornado wind damage probability and recurrence for West Valley, New York. A maximum ground level wind velocity of 170 mph and a pressure drop of 1.0 psi in 5 seconds are requested as criteria. Missile velocity criteria were also developed. It was adjudged that the recurrence interval for such a tornado is significantly longer than once in 50,000 years. (M.C.G.)

50625 (HN-20-1045) ARCHAEOLOGICAL REPORT: SITE 49 RAT 32, AMCHITKA ISLAND, ALASKA. Cook, John P. (Alaska Univ., College). May 1972. Contract AT(29-2)-20. 149p. Dep. NTIS.

For Holmes and Narver, Inc., Las Vegas, Nev.

It was feared that the archeological site, 49-RAT-32, would be endangered by the Cannikin nuclear test detonated on Amchitka Island, Alaska, during the fall of 1971. Because of the site's proximity to ground zero and its position on an actively eroding bluff, it was suspected that ground motion resulting from the blast would adversely affect the site. Therefore, action was taken to salvage the site. Field work began on Amchitka Island on June 3 and was completed on July 26, 1971. Analytical work, including radiocarbon dating, was performed, and the archaeological data was compiled and analyzed. The field work, analysis, and tentative conclusions of the archaeological study of Site 49-RAT-32 are presented. (L.C.L.)

50626 (JAERI-M-4657) ANNUAL REPORT OF METEOROLOGICAL DATA AT OARAI-SITE, 1970. (Japan Atomic Energy Research Inst., Tokyo). Dec 1971. 33p. (In Japanese). NTIS (U. S. Sales Only).

The data presented cover the one-year period of 1970. Meteorological statistics are given in the form of monthly summaries, which include daily and hourly averages of wind speed and other elements, occurrence frequencies of wind direction and atmospheric stability categories, and others. (auth) (Japan)

50627 (TID-25857, pp 51-6) THE NUCS: ENERGY VS THE ENVIRONMENT. Tydings, Joseph D. 1972.

In Environmental and ecological forum, 1970-1971.

The compatibility of nuclear energy and electric power with the environment is discussed. The situation at this point of time is whether or not this country is willing to pay the cost and make the effort necessary to fulfill environmental considerations in the siting, design, and operation of nuclear power plants. Congressional bills and AEC standards are discussed. (P.C.H.)

50628 (UM-RSMAS-72060) ECOLOGICAL STUDY OF SOUTH BISCAYNE BAY AND CARD SOUND. Progress Report. Bader, R. G.; Roessler, M. A. (Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences). Jun 1972. Contract AT(40-1)-3801-4. 289p. Dep. NTIS.

A quantitative study is presented of the ecology of South Biscayne Bay and Card Sound, Florida, with particular attention to the areas adjacent to Turkey Point and the mouth of the Model Land Company Canal. The study site was selected because national attention has been brought to bear on this site by Federal hearings (24 February 1970) and court proceedings of March 24 to 26, 1970, on the effects of thermal additions from Florida Power and Light Company's Turkey Point power plant. The Turkey Point program began in 1968 and has continued to the present time. The Card Sound environment was monitored from July 1970 to February 1972 to determine baseline data, and since the opening of the cooling canal on February 14, 1972, data on the effects of the silt and heat from the canal have been measured. These baseline data include measures of hydrography, chemistry, vegetation, planktonic and benthic organisms. The biology of the organisms has been considered in relation to temperature, radioactivity, salinity ranges and selected chemical characteristics. The effect of higher temperatures on the dominant and subdominant species has also been studied both in the laboratory and in the field. (L.C.L.)

Thermal Effluents

Refer also to abstracts 52456, 52480, 52483, 52519, and 52539.

50629 (COO-4217-2) MATHEMATICAL ANALYSIS OF THERMAL POLLUTION OF LAKES AND ESTUARIES. McLay, Richard W.; Hundal, Mahendra S.; Martinek, Frank; Henson, E. Bennette (Vermont Univ., Burlington. Dept. of Mechanical Engineering). May 1972. Contract AT(30-1)-4217. 114p. Dep. NTIS.

Mathematical models for predicting nuclear power plant thermal discharges in large lakes and estuaries are presented. The models simulate these effects in three regimes: an open channel outfall, a mixing zone close to shore, and a floating plume at a large distance from shore. The effects of mass and energy exchange with the environment are included. Programs, written in FORTRAN IV, are presented that implement the models. A sample problem is shown. (auth)

50630 (HEDL-TME-72-69) THERMAL EFFECTS OF PROJECTED POWER GROWTH: LOWER MISSISSIPPI RIVER BASIN. Peterson, D. E.; Schrotke, P. M. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 120p. Dep. NTIS.

Direct cooling capacities of the Lower Mississippi River and six tributaries, excluding the Missouri and Ohio Rivers, were calculated for average and low flow conditions. Total assimilative and dissipative capacity for the section extending from Alton, Illinois to the mouth (1156 river miles) ranged from a high of 464 GW_T to a low of 137 GW_T. At the 1969 average once-through thermal rejection ratio of ~1.6 [MWT/MWe] for the Lower Mississippi Basin, the upper limit for direct cooled electrical generation would be 86 GW_e on the main stem at a 100% capacity factor and under low monthly conditions. Analyses of projected power generation patterns indicate that the Mississippi River has adequate heat sink capacity for once-through cooling requirements through 1990. Regional planning of thermal discharge sites will be most important in the St. Louis area. Larger tributaries such as the Yazoo, Arkansas and Red Rivers are affected by low flow conditions to an extent that closed cycle cooling would be expected in the middle and upper reaches for steam plants in the 500 MW_e class and variable cycle or closed cycle in the lower sections. A short section of the White River, upstream of the White River National Wildlife Refuge, could support 500 MW_e units by direct cooling under average and low flow conditions. Smaller tributaries, such as the Meramec and St. Francis, are expected to require closed cycle cooling along their entire length. The Atchafalaya River, a major distributary between the Mississippi and the Gulf, has a large heat sink capacity, but a paucity of sites in association with flood-way zoning. (auth)

50631 THERMAL EFFECTS OF POWER PLANTS ON LAKES. Moore, F. K.; Jaluria, Y. (Cornell Univ., Ithaca, N. Y.). J. Heat Transfer; 94: No. 2, 163-8(May 1972).

The natural thermal cycle of a stratified water body used for power-plant cooling will be disturbed both by heat addition and the mixing effect of withdrawal and return. A perturbation analysis for these effects is made with a model based on the assumption that a Richardson number is constant at the base of any stratified layer. On a further assumption about the profiles of wind-driven return currents, constant heat flux from that layer is inferred. This heat flux, and the diffusion coefficient at the thermocline, are the critical parameters of the simple one-dimensional line-segment model, and are chosen to give good imitation of the known natural cycle of Cayuga Lake. The model is then perturbed in terms of both heat flux and diffusion to give power-plant impact for that lake. Both transient and final cycle changes of summer and winter temperatures and stratification and overturn are calculated. It is shown that the heat and diffusion effects are comparable, and that the latter may be dominant if the discharge is diluted to meet a thermal standard. Certain implications as to strategy of water use are developed. (auth)

50632 ENERGY TECHNOLOGY AND THE ENVIRONMENT. Schaefer, H. (Deutsche Komitee der Weltenergiekonferenz, Mannheim, Ger.). Brennst.-Waerme-Kraft; 24: No. 7, 280-2 (Jul 1972). (In German).

The thermal load on the environment due to the production of energy is considered. It is necessary to examine possibilities for reducing final energy requirements. These are to be found in improvements in the efficiency of utilization in the domestic and industrial sectors. The extent the waste heat from thermal power stations may be utilized, a problem which, for large units, appears almost insoluble, is considered. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 51959 and 52219.

General Detectors and Monitors

Refer also to abstracts 50731, 50740, 50745, 50980, 51250, 51251, 53205, and 52342.

50633 (AD–735649) DEVELOPMENT AND APPLICATION OF A WHOLE-BODY RADIATION SYSTEM. Scaief III, Charles C.; Krzywicki, Harry J. (Army Medical Research and Nutrition Lab., Denver, Colo.). 12 Nov 1971. 31p. (USAMRNL–330). NTIS.

An instrument for detecting natural body burdens of radionuclides has been constructed at USAMRNL. The counting system uses a NaI(Tl) scintillation crystal and a lead shadow-shield. The subject passes beneath the detector on a padded sled at a speed proportional to the live time of the multichannel analyzer. Data are analyzed using the RCA 301/355 computer and punched paper tape. The detector was calibrated for measuring body potassium using six subjects with weight/height ratios varying from 0.368 to 0.620 kg/cm. The calibration factor was found to be a linear function of weight/height for the range of body sizes considered. The counter has been used for measuring potassium, for body composition studies, and for tracer isotope retention measurements. (GRA)

50634 (AD–740100) LARGE-AREA DETECTOR FOR NEUTRONS BETWEEN 2 AND 100 MeV. Grannan, R. T.; Koga, R.; Millard, W. A.; Preszler, A. M.; Simnett, G. M. (California Univ., Riverside. Inst. of Geophysics and Planetary Physics). 1 Feb 1972. Contract N00014-69-A-0200-5001. 35p. (IGPP-UCR–72-2). NTIS.

A neutron detector sensitive from 2 to 100 MeV is described. The detector is designed for high altitude balloon flight to measure the flux, energy and direction of albedo neutrons from the earth and to search for solar neutrons. A neutron scatter from a proton is required in each of two liquid scintillator tanks spaced 1 meter apart. The energy of the recoil proton in the first tank is obtained from pulse height analysis of the scintillator output. The energy of the recoil neutron is obtained from its time of flight between the tanks. The detector has been calibrated with 15.3 MeV neutrons and mu mesons. The minimum detectable flux is 0.0001 neutron/square cm-sec at a counting rate of one per minute, the energy resolution is 12% at 15 MeV and 30% at 100 MeV. The angle between the incoming neutron and the recoil neutron is measured to plus or minus 10 degrees. (auth) (GRA)

50635 (ANL–7860(Pt.1), pp 38-43) PRELIMINARY STUDIES OF PULSE-SHAPE ANALYSIS IN THE NANOSECOND REGION. Berlman, I. B.; Steingraber, O. J. 1971.

In Radiological Physics Division annual report, July 1970–June 1971.

Some of the mechanisms that contribute to the pulse contour are investigated. The preliminary results indicate that pulse discrimination as a method for differentiating between scintillation pulses produced by various types of ionizing particles is enhanced by materials with a high phosphorescence yield and long decay time and is reduced by those compounds that form excimers. (auth)

50636 (ANL–7860(Pt.1), pp 44-51) APPARATUS FOR MEASURING FLUORESCENCE PULSE CONTOURS FROM LIQUID SOLUTIONS EXCITED BY IONIZING PARTICLES. Berlman, I. B.; Steingraber, O. J. 1971.

In Radiological Physics Division annual report, July 1970–June 1971.

A signal-averaging apparatus for accurately recording scintillation pulse contours is presented, as are some sample pulse spectra. A favorable characteristic of this equipment is that a pulse shape can be determined in about 15 min. (auth)

50637 (BNL–17025) RADIATION MONITORING AND ALARM SYSTEM (AMOS II) FOR HABITABLE AREAS OF AN ACCELERATOR COMPLEX. Picinich, Louis M.; Distenfeld, Carl H. (Brookhaven National Lab., Upton, N. Y.). [nd]. 27p. (CONF-720614–2). Dep. NTIS.

From Health physics annual meeting; Las Vegas, NV. (12 Jun 1972).

AMOS II was developed as a radiation monitor for use in experimental areas of the Alternating Gradient Synchrotron (AGS). AGS pulse width variations, several microseconds to one second within standard repetition rates, dictate the use of an integrating type detector. The detector assembly consists of a polyethylene lined, ethylene filled integrating pulse discharge ionization chamber (IPDIC) and associated electronics. This assembly may be operated remotely from the AMOS II chassis. The alarm feature is field adjustable and consists of local audio and visual indicators plus a remote area coded alarm sent via radio telemetry to Health Physics Operations. Manual reset of this alarm initiates reminder alarms of 10 seconds duration and repetition periods inversely proportional to dose rates, as long as the alarm condition exists. Interconnected AMOS II units will allow simultaneous operation of alarm indicators without affecting the independent operation of the individual units. Local indication of prevailing dose rates is accomplished using five dose rate bands to display possible area worktime limitations directly in days or weeks. A detector failure alarm is incorporated in the ratemeter function. Unique modular design was employed to facilitate interchangeability and ease of maintenance. (auth)

50638 (DESY-F–70/9) COMPARATIVE MEASUREMENT OF ABSORPTION LENGTH IN SEVERAL ORGANIC SCINTILLATORS. Quehl, H.; Stuckenberg, H.-J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1970. 7p. (In German). Dep. NTIS (U. S. Sales Only).

The absorption curves of NE 110, NE 102A, NE 104, Pilot B, Pilot Y, Nuplex 3, and Nuplex 4 were measured. The absorption coefficients and absorption lengths were calculated and are tabulated. (J.S.R.)

50639 (DP-MS–72-18) MONITORS FOR ALPHA AND BETA ACTIVITY IN AIR EXHAUST DUCTS AND STACKS. Moyer, R. A.; Hayes, G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 9p. (CONF-720823–6). Dep. NTIS.

From 12th air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

At the Savannah River Laboratory, exhausts from a variety of containment facilities discharge into five main stacks, from which samples of air are passed through fiberglass filters mounted on charcoal canisters. Low-range and high-range monitor systems provide continuous surveillance of the accumulating radioactive deposits on the air sample assemblies, and give prompt visible and audible warnings in the event ventilation filters fail or operating abnormalities release radionuclides from exhaust stacks. The low-range system actuates a warning alarm at variable alarm set points. When the radiations from the deposit exceed the measurement range of the low-range system, a corresponding logarithmic high-range system detects the deposit. Alarms of the high-range system are actuated at an alert level and at a higher preset level which requires initiation of an emergency action plan. Wind speed and direction recorders are also mounted in the instrument consoles. The high-range system is designed to remain on scale for any credible accident. (6 figures) (auth)

50640 (EUR–4810(Vol.1), pp 455-69) PRELIMINARY MEASUREMENTS USING A LOW PRESSURE CLOUD CHAMBER OF THE RANGES OF LOW ENERGY ELECTRONS. Hodges, D. C.; Delafield, H. J.; Dennis, J. A. (Atomic Energy Research Establishment, Harwell, Eng.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A new low-pressure cloud chamber was designed, based on experience gained with H. J. Delafield's chamber (Proc. 2nd L. H. Gray Conference, 1969, pp. 35-41). Many of the previous problems have been overcome. Some photographs of the tracks produced by 1.5-keV aluminum x rays are presented. The potentialities of the chamber and some of the difficulties associated with interpreting these photographs are discussed. (auth)

50641 (HEDL-TME–72-47) PERFORMANCE TESTING OF COMMERCIAL EQUIPMENT FOR IN-VESSEL NEUTRON MONITORING IN FAST REACTORS. Hoitink, N. C.; Jackson, C. N.; Thompson, D. C.; Spear, W. G. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. Contract AT(45-1)-2170. 71p. Dep. NTIS.

Progress made at HEDL in a testing program to evaluate the performance of commercially available fission chamber neutron detectors and cables in the gamma and temperature environments (10^6 R/hr and 300°F) expected at the in-vessel FFTF neutron sensor location is described. Six detector-cable preamplifier systems were tested over periods ranging from six to eleven months. Three test systems showed satisfactory performance. Three systems failed as a result of problems associated with the fission-counter detectors. (auth)

50642 (INR–1402) HALOGEN QUENCHED MINIATURE G–M COUNTERS TYPES DOI-30 AND DOI-80. Kowalska, Ewa;

Jankowski, Maciej; Marciniak, Stefan (Institute of Nuclear Research, Warsaw (Poland)). 1972. 27p. (In Polish). Dep. NTIS (U. S. Sales Only).

Basis parameters and performance characteristics of the halogen quenched miniature G–M counters types DOI-30 and DOI-80 are described. The counters are designed for high exposure dose rates up to 500 R/h for DOI-30 and up to 5 R/h for DOI-80. The factors influencing the instabilities and life expectancies of the counters are also reviewed. (auth)

50643 (JAERI-M–4648) TEMPERATURE CHARACTERISTICS OF THE NaI(Tl) SCINTILLATION COUNTER. Nakata, Hirokatsu; Takeda, Takashi; Nakamura, Kunio (Japan Atomic Energy Research Inst., Tokyo). Nov 1971. 21p. (In Japanese). NTIS (U. S. Sales Only).

In the Japan Materials Testing Reactor (JMTR), the gamma rays from ^{16}N in primary coolant water is measured as the output monitor of the reactor. The detector is located near the piping of primary coolant, and it is influenced by the temperature of the primary coolant. Therefore, the temperature characteristics of scintillation counters must be known. The temperature characteristics of a NaI(Tl) scintillation counter were studied in the range of 0 to 50°C. The output wave-form, i.e. the wave height and half-width of the photomultiplier depends strongly on the temperature, the shift of wave height originating mainly in the scintillator itself. The scintillation energy level of the model is higher by W_f than that of the excited level of a Tl^+ center in the scintillator. Since the output wave-forms indicate a charge conservation, the shift of wave height may be reduced by using a charge-sensitive amplifier. A good agreement is obtained between the experimental values and the theoretical ones. (auth) (Japan)

50644 (JAERI-Memo–3913) DEVELOPMENTS OF BORON TYPE IN-CORE NEUTRON MONITORS FOR JPDR. Yokota, M.; Shirayama, S.; Kasai, M. (Japan Atomic Energy Research Inst., Tokyo). Feb 1970. (In Japanese). NTIS (U. S. Sales Only).

The monitor has a dimension of 6 mm outside diameter and 40 mm sensor length. Natural boron is coated at the inside surface of the outer electrode as a neutron sensitive material. Most of the mechanical components had been tested to insure the behavior in high temperatures, high pressures, and reactor radiation. The first monitor was assembled and installed into the JPDR reactor core in 1966 followed by second and third monitors for long term operation tests. They are operating under the total neutron flux of 10^{20} nvt and showing good characteristic of plateau, linearity, neutron sensitivity and dynamic response. From these experiments, it is believed that the in-core monitors are capable of operating as reactor power range monitors. (auth) (Japan)

50645 (JEN–247) NEW APPROACH TO BETA–GAMMA COINCIDENCE COUNTING. ADVANCE REPORT ON THE "SAMAR" ELECTRONIC SYSTEM. De Carlos, J. E.; Granados, C. E. (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica). 1972. 42p. (In Spanish). Dep. NTIS (U. S. Sales Only).

In 4π β-γ coincidence measurements, precision on the evaluation of coincidence counting losses is made difficult because of complex overlapping effects between the β- and γ-side dead times due to precursive counted events. In this context the SAMAR electronic system is aimed to give a precise way of automatic counting and reduce the need for calculated corrections. The configuration and basic features are described. The SAMAR has been conceived in such a manner that both beta and gamma chains are sharing a common and nonextending dead time which is simultaneously applied to both channels. The shared dead time is made to be the only one inserted throughout the chains. Overlapping effects vanish and the three counting channels have identical transmission ratios. A new dead time circuit based on fast linear gates as blocking elements has been developed. Application of the two-oscillator Mueller's method evidences a fully non-extending character. Automatism is implemented by using a live timer corrective channel for controlling the counting scalers. (auth)

50646 (JINR–P13–6515) SURFACE-BARRIER Si-DETECTORS OF LARGE AREA. Vil'gel'm, I.; Gumnerova, L. I.; Kratsikova, I.; Li Chen Son; Osipenko, B. P.; Prakhov, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

A possibility is described of preparing surface-barrier Si-detectors (their working area being 5.0 to 8.5 cm²) for heavy charged particle spectroscopy. The detectors are made of n-type material, cut along the axis III in plates with a spread in resistivity and lifetime of 25% on the working length. The energy resolution for ^{239}Pu + ^{241}Am particles does not exceed 80 keV at room temperature. In the best cases it was less than 60 keV. (auth)

50647 (ORNL–TM–3906) IONIZATION CHAMBER CURRENT QUANTIZER FOR RADIOLOGICAL ENVIRONMENTAL MONITORING SYSTEM. Glass, F. M. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 24p. Dep. NTIS.

A current-to-frequency converter, having a total leakage current $<10^{-14}$ A, was developed as an ionization chamber current quantizer. This instrument measures currents from 0.5×10^{-10} to 0.9×10^{-6} A without range-switching, which corresponds to a radiation range from 0.5 to 10,000 R/hr when used with a 1000-cc standard air equivalent chamber. The output of the converter is positive pulses having a frequency directly proportional to the ionization current. The calibration is adjustable within a range from 2.4×10^{-11} to 9×10^{-11} coulomb/pulse. Built-in current sources enable a check of the calibration. The instrument has a high tolerance for gamma radiation, humidity, and ambient temperature. (auth)

50648 (TID–26118) SELECTED EXPERIMENTS FOR NUCLEAR MEDICINE INSTRUMENTATION. Beihn, R. M. (comp.) (Oak Ridge Associated Universities, Inc., Tenn.). Feb 1972. 127p. Dep. NTIS.

Twenty laboratory experiments for instruction in the operational methods and principles of nuclear medicine instrumentation are detailed. The experiments are designed to help the student develop an understanding of the operation of uptake probes, radioisotope scanners, dual probe radioisotope scanners, and gamma cameras. (W.H.K.)

50649 ELECTROMETRIC PHOTOELECTRIC COMPENSATOR AND ITS USE IN RADIATION MEASUREMENT. Rothe, H.; Willuhn, K. (Deutsches Amt fuer Messwesen und Warenpruefung, Berlin). Isotopenpraxis; 8: No. 4, 121-9(Apr 1972). (In German).

For charge and current measurement performed with standard ionization chambers in order to obtain and transmit radiological units of measurement, preference is given to compensation methods with efforts being directed towards vast automation of the compensation process to increase efficiency of measurement. The design and mode of operation of the electrometric photoelectric compensators used by the DAMW (Deutsches Amt für Mebwesen und Warenprüfung) for this aim are described and some further fields of application indicated. Special stress is laid on the measurement of physical quantities, which are often used as prerequisites for radiation measurement (e.g. capacity of condensers, characteristic value of high-impedance resistances, voltage of X-ray generators), as well as on their use as a variable current standard. Finally, some aspects of further development of photoelectric compensators are considered. (auth)

50650 PHOTOMULTIPLIERS. Schonkeren, J. M. Kater, H.; Thompson, L. J. (eds.). Eindhoven, Netherlands; N. V. Philips' Gloeilampenfabrieken (1970). 157p.

Topics include the construction and operation of photomultipliers (photocathode, electron-optical input system, and multiplier system); operational considerations (influence of excessive illumination and ambient temperature, supply voltages, magnetic fields, and method of illuminating the photocathode); photomultiplier characteristics (cathode sensitivity, gain and anode sensitivity, dark current, and noise); and photomultipliers in practice (comparison of the different measuring circuits and refrigerating photomultipliers). (W.H.K.)

50651 ESTIMATE OF ERROR LATITUDE INHERENT IN SPHERICAL–MODERATOR MEASUREMENT FOR NEUTRON DOSIMETRY. Rossbander, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 2, 72-3(Feb 1972). (In German).

Measurement devices with polyethylene spherical moderators and $^6LiI(Eu)$ detectors were constructed for the determination of neutron energy distributions, flux rates, dose output, and dose equivalent output. The error latitude in the determination of the flux rate, dose output, and dose equivalence output was calculated and the results are tabulated. (J.S.R.)

50652 APPARATUS FOR THE MEASUREMENT OF TRITIUM ACTIVITY. Froehlich, K.; Hebert, D.; Andreev, A. (Bergakademie, Freiberg, Ger.). Isotopenpraxis; 8: No. 4, 130-5(Apr 1972). (In German).

The construction, mode of operation, and properties of an apparatus allowing measurement of tritium activity of surface and ground water are described. The measurement comprises four steps: electrolytic enrichment of natural tritium concentrations, determination of enrichment factor by means of a liquid scintillation counter, synthesis of ethane from enriched sample water and tritium-free acetylene, and determination of tritium in ethane by means of a proportional counter. The lower detection limit (metering time 48 hours, statistical error 50%) is 1 TU. (auth)

50653 GAS-COUNTING APPARATUS FOR THE DETECTION OF TRITIUM. Thiemt, K. (Technische Univ., Dresden). Isotopenpraxis; 8: No. 4, 135-9(Apr 1972). (In German).

A flowthrough gas-counting apparatus comprising a vacuum device and an anticoincidence counter to be used for the determination of tritium-labeled hydrogen is described. The presented apparatus provides detection of 1.5×10^{-11} mols of hydrogen with the specific ^{3}H-activity of the solution ranging 25 mCi/ml. Besides H_2^* and other compounds containing tritium, the apparatus may as well be used for the investigation of gases labeled with ^{14}C or ^{35}S. (auth)

50654 DUAL REGION-OF-INTEREST SYSTEM AND A PROPOSED SYSTEM FOR MAGNETIC RECORDING OF GAMMA CAMERA IMAGES. Steven, L. W. (Royal Melbourne Hospital). Australas. Bull. Med. Phys. Biophys.; No. 54, 3-10(1 Jun 1972).

A simple electronic system is described which enables the two simultaneously occurring output positioning pulses from an Anger scintillation camera to be recorded in direct analog form on the video track of a commercial video tape recorder, with a total system dead time of 9 microseconds. A system has been constructed which enables the user to electronically select two independent and variable regions of interest for count rate analysis either on reply of the original information or during the recording process itself. (auth) (Australia)

50655 COUNTING EFFICIENCY FOR ^{55}Fe AND OTHER E.C. NUCLIDES IN LIQUID SCINTILLATOR SOLUTIONS. Gibson, J. A. B.; Marshall, M. (Atomic Energy Research Establishment, Harwell, Eng.). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 321-8(Jul 1972).

It has been suggested that nuclides decaying by electron capture might be counted with efficiencies of up to 90%. Realistic estimates of the counting efficiency are presented for a coincidence system based upon measurements with ^{55}Fe and ^{3}H and calculations are made of the probability for the escape of fluorescent x-rays and of the energy deposition from Auger electrons. It is shown that the ratio of the counting efficiencies for ^{55}Fe to ^{3}H, ϵ^{55}Fe/ϵ^{3}H is less than unity for a figure of merit $P \sim 0.5$ e keV^{-1} and ^{55}Fe will be more effected by quenching than ^{3}H up to $P \sim 0.7$ e keV^{-1}. Above this level the ϵ^{55}Fe/ϵ^{3}H decreases since ϵ^{3}H decreases more rapidly than ϵ^{55}Fe. The calculated efficiency for other nuclides varies from 8 to 72% for ^{37}Ar and ^{205}Pb, respectively at $P = 0.25$ e keV^{-1} and from 23 to 95 for the same isotopes at $P = 0.50$ e keV^{-1}. Problems in producing solutions of the isotopes in the liquid scintillator involve the use of less efficient scintillators and typical values of less than 30% for ^{55}Fe will be normal until improved solubilizers are available. (auth)

50656 LIQUID SCINTILLATION QUENCHING AGENTS FROM FILTER PAPER. Cramer, C. F.; Arnott, S. G. (Univ. of British Columbia, Vancouver). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 339(Jul 1972).

When using the paper strip method of sample preparation for assaying ^{45}Ca by liquid scintillation, the fluor solution can be reused after simple filtration. However when re-using self absorption standards on paper without changing the fluid, an anomalous factor was detected whereby freshly prepared standards showed higher channels ratio than the highest efficiency standard. The cause of this effect is not proved but a simple cure is possible. (UK)

50657 LIQUID SCINTILLATION ALPHA-PARTICLE DETECTION APPLIED TO ENVIRONMENTAL AND MEDICAL RESEARCH. McKlveen, J. W.; Berk, H. W.; Johnson, W. R. (Univ. of Virginia, Charlottesville). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 337-8(Jul 1972).

The technique of liquid scintillation detection provides a rapid, reliable, low background method for mass sample alpha-particle analysis. The simple, inexpensive process and equipment are described. Representative results for a variety of samples including animal bones, teeth and fertilizer are given. Possible errors arising from interference from the presence of β-particle activity are discussed. (UK)

50658 COMPATIBILITY OF COMMERCIAL TISSUE SOLUBILIZERS WITH THREE PRIMARY SCINTILLATION FLUORS. McEvoy, A. F.; Dyson, S. R.; Harris, W. G. (New England Nuclear Corp., Boston). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 338(Jul 1972).

The interaction of the following commercial tissue solubilizers; hyamine hydroxide, Soluene-100, NCS Solubilizer, Protosol tissue and gel solubilizer, and Eastman Tissue Solubilizer with the three primary liquid scintillation fluors, PPO, butyl-PBD and isopropyl-PBD produced in some cases severe color quenching. Results, in terms of tritium counting efficiencies of a standard, are tabulated and show that Soluene-100, NCS Solubilizer and Eastman Tissue Solubilizer provide lower tritium counting efficiencies when used with the scintillator solution containing either butyl-PBD or isopropyl-PBD. While all five solubilizers performed satisfactorily with PPO only, Hyamine hydroxide and Protosol Tissue and Gel Solubilizer maintained these levels of performance in the presence of all three primary fluors. (UK)

50659 PERFORMANCE CHARACTERISTICS OF AN ULTRA-PURE GERMANIUM GAMMA CAMERA. Detko, John F. (Sloan-Kettering Inst. for Cancer Research, New York). Radiology; 104: No. 2, 431-3(Aug 1972).

Preliminary data indicate that the more stable bulk and surface properties of ultra-pure germanium diodes make them better suited for the construction of a practical orthogonal-strip gamma camera than lithium-drifted germanium diodes. (auth)

50660 TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK II. (Proceedings of the Union Research Institute of Instrument Construction. Issue II). Matveev, V. V. (ed.). Moscow; Atomizdat (1965). 192p.

This second annual appearance of a new journal brings together a total of 23 papers by workers in the field of radiation measurement and dosimetry. Papers pertaining to measurement of, and errors in, ''latent energy,'' assaying radioactive aerosols, the optimum geometry for measuring low gamma activity by a scintillation counter, and the compensation of the natural background of beta activity for the measurement of low concentrations of artificial beta activity are included. Determination of self-absorption in beta sources, such as ^{60}Co, and in ^{204}Tl sources is considered. A short review article on iodine radiometry with 20 references is presented. A nomogram was constructed for calibrating gamma dosimeters. Methods are suggested for determining RaA, RaB, and RaC in air samples, and fission products of ^{235}U and ^{239}Pu suspended in the air. (K.S.W.)

50661 TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK III. (Proceedings of the Union Research Institute of Instrument Construction. Issue III). Matveev, V. V. (ed.). Moscow; Atomizdat (1966). 204p.

This publication represents the third annual release of a collection of reports on nuclear instrumentation. These 27 articles indicate the developmental trends in radiation sources, spectrometry, dosimetry, and refinements in components for such equipment. Several papers are devoted to α emitters and radiation, phosphors for recording the latter, and α spectrometry for low-level activity in aerosols. Beta sources are discussed, and the properties of secondary electron emission from precipitated PbS and PbSe films are detailed. Scintillators and the spectrometry of soft gamma and x rays are examined in four papers. The radioactive decay of ^{85}Sr was closely studied. Equipment development was reflected in logarithmic millivolt meters, logarithmic amplifiers, tunnel diodes, and diodes with accumulated charge for digital computers, external dosimetry and automatic systems, and an ionization chamber for gamma dose assay over a broad energy range. Two review papers are included: an application of the luminescence method in the measurement of ionizing radiation (12 references), and scintillation gamma spectrometers with improved functional characteristics. (K.S.W.)

50662 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK VII. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue VII). Matveev, V. V. (ed.). Moscow; Atomizdat (1967). 125p.

This collection of 11 articles by various authors is concerned with the theory and design of detectors, scintillation counters, multichannel analyzers, and gamma resonance spectrometers. Detailed schematics and block diagrams are employed in many of the descriptions, and frequent usage of semiconductors is to be noted. A review of soft electrons and their measurement in the upper reaches of the earth's atmosphere (53 literature references) is included. (K.S.W.)

50663 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK X. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue X). Matveev, V. V. (ed.). Moscow; Atomizdat (1969). 135p.

This set of 13 papers is devoted to a variety of subjects pertinent to nuclear instrumentation. The efficiency for gamma detection of a NaI(Tl) crystal as calculated by a Monte Carlo method, dose meters for 10^4 R/sec, and remote dosimetry are discussed. The noise level factor in instrumentation plays a role in three papers. Two papers examine radiometric analyses of uranium: by alpha and by gamma radiation. The latter article is in the form of a review and contains a list of 16 references. (K.S.W.)

50664 PREPARATION OF A SEMICONDUCTOR NUCLEAR DETECTOR. Meuleman, Johannes (to La Radiotechnique-

Compelec). French Patent 2,074,755. 8 Oct 1971. Filed 26 Jan 1970. (In French).

A nuclear detector with a crystal semiconductor in which two external regions of opposite type conductivity are formed is described. The regions are separated by an intrinsic region obtained by compensating a P type region with Li. The two opposite type conductivity regions are dished, the dishings being of similar shape and arranged to face one another. One dishing serves as the radiation input window; it possesses a depth at least equal to the thickness of the external region. The other dishing in the region of opposite conductivity is of the same form. The dishing of the radiation input region avoids the undesirable effects of the nonintrinsic regions. A pile of such detectors does not perturb the passage of the radiation as the external noncompensated region opposite to the input window is suppressed. Contact regions are provided around the periphery of the dishings, and in this way masking effects are avoided. (France)

50665 METHOD OF RECORDING THE TRACKS OF IONIZING PARTICLES. Audran, R. G.; Renard, G. G. (to Societe Kodak-Pathe). French Patent 2,092,829. 28 Jan 1972. Filed 23 Jun 1970. (In French).

A method of recording the tracks produced by ionizing particles in a plastic material is presented. The method enables photographic reproductions of the tracks to be made by contact. A colored cellulose material is used. The thickness of this material is chosen in relation to the ionizing particles under consideration and the etching process envisaged, such that it exceeds the maximum length of the particle tracks. After irradiation, the material is treated with an alkaline reagent, such that the particle tracks are revealed in the colored material. In the case of the colored material considered, this density difference is sufficient to allow a photograph to be made by contact. In neutron radiography, the secondary α emission resulting from the conversion of a neutron flux is also recorded. The cellulose material is, in this case, covered with a conversion layer (lithium borate), which is dissolved away by treatment with warm water. (France)

50666 DIRECTIONAL PROPERTIES OF A COMBINED SCINTILLATION DETECTOR. Petr, Ivo. Jad. Energ.; 18: No. 8, 258-65(Aug 1972). (In Czech).

The basic idea of using a combined scintillation detector (i.e. the detector consisting of two different scintillators viewed by a common photomultiplier) for the directional detection of gamma-rays is based on the fact that one scintillator shields the other against the incident gamma-rays. The shielding effect depends on the direction and energy of incident photons as well as on the material and dimensions of both scintillators. If the pulses corresponding to each scintillator could be separated and their counting rates evaluated in an appropriate manner (e.g. subtracted from each other) then such a detector would exhibit a directional sensitivity without any additional screening. (auth)

50667 FAST RESPONSE PHOTOMULTIPLIERS. Hull, M. D. (ed.). Eindhoven, Netherlands; N. V. Philips' Gloeilampenfabrieken (1971). 122p.

Topics include principal properties of the photomultiplier; amplitude fluctuations in a photomultiplier (quantum efficiency, overall collection efficiency, statistical behavior, dark current noise, and energy resolution); time fluctuations in a photomultiplier (speed of response, effect of statistical fluctuations on response time, transit-time spread and transit-time difference, performance of some fast response photomultipliers, and photomultiplier XP 1210); achievement of high peak currents in pulses (improving the linearity of the current and photomultiplier type XP 1143); fast response photomultipliers in nuclear physics (measurement of high-energy particle velocity and studies on heavy high energy particles); and detection of modulated light by photomultipliers (optical receivers, sensitivity limit of photomultipliers for modulated light, and passband). (W.H.K.)

50668 HIGH TEMPERATURE PERFORMANCE OF IN-CORE SELF-POWERED NEUTRON DETECTORS. Sekiguchi, Akira; Koizumi, Yoshinobu (Tokyo Univ.). Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo; 30: 263-6(Sep 1971). (In Japanese).

The performance of the double-emitter-type self-powered neutron detectors was investigated in the thermal test facility in the reactor by using the thermostatic chamber. Double-emitter-type detectors were capable of functioning up to at least 500°C in the reactor core, in contrast with the upper usable range of 300°C of the single-emitter type. The performance of the self-powered detectors coupled with a thermocouple was also studied. Good results were obtained. (auth) (Japan)

50669 DETERMINATION OF ALPHA EMITTING PARTICLE SIZE BY AUTORADIOGRAPHY USING ZnS(Ag) POWDER SCREEN. Ohata, Tsutomu; Murata, Mikio; Nakato, Kiyori; Niino, Futao (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 7: No. 1, 3-6(Mar 1972). (In Japanese).

Autoradiography using a ZnS(Ag) powder screen was studied for estimating the particle size of alpha-emitting dust collected on an air sampling filter paper. The sensitivities of three commercial emulsion films for the detection of plutonium particles were compared by using a ZnS(Ag) powder screen. The effect of particle size of ZnS(Ag) powder on the sensitivity was examined; in addition, the change of apparent particle size distribution with exposure time was examined. It was found that the sensitivity of a polaroid film is about 10 times higher than that of the x-ray films and the minimum detectable activity for the polaroid film is 0.01 dpm for the exposure of 163 hours, which is equivalent to the diameter of 0.25 μ for a $^{239}PuO_2$ particle. (auth) (Japan)

Radiation Dosimeters

Refer also to abstracts 50857, 50863, 50925, 50969, 52229, 52259, and 52617.

50670 (COO-1105-175) FAST NEUTRON DOSIMETRY USING ACTIVATED TL PHOSPHORS. Pearson, D.; Wagner, J.; Moran, P. R.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Physics). [nd]. 8p. Dep. NTIS.

The performance of LiF and Mg_2SiO_4 : Tb thermoluminescent detectors for fast neutron dosimetry based on the activation reactions $^{19}F(n,2n)^{18}F$ and $^{24}Mg(n,p)^{24}Na$ and the subsequent decay of ^{18}F and ^{24}Na was studied. The LiF prompt dose sensitivity to 14 MeV neutrons was found to be 0.2 equiv. R/tissue rad and the self dose sensitivity was ~1 mR/tissue rad. The Mg_2SiO_4 : Tb prompt dose sensitivity to 14 MeV neutrons was found to be 0.15 equiv. R/tissue rad and the self dose sensitivity was 2 mR/tissue rad. (W.H.K.)

50671 (COO-1105-176) USE OF LIGHT SCATTERING IN FAST NEUTRON DOSIMETRY; PRELIMINARY RESULTS ON LUCITE. Wagner, Jerome (Wisconsin Univ., Madison). [nd]. 11p. Dep. NTIS.

A preliminary quantitative study of the use of Rayleigh scattering for fast-neutron dosimetry is reported. Commercial sheet lucite was used to determine the Rayleigh scattering response to fast neutrons and gamma rays by looking at the right-angle scattering caused by a red He–Ne laser. A qualitative study of background scattering of various materials was made to determine some criteria useful in choosing materials. It was concluded that Rayleigh scattering from neutron radiation damage has practical potential for fast-neutron dosimetry. The radiation detection sensitivity of this technique can depend critically on the details of composition and manufacture of the scattering material. Although the results indicate little encouragement for Rayleigh scattering at personnel monitoring dose levels, it appears to be a very simple method with promise for usefulness in and above accident dose levels. (4 figures) (R.W.R.)

50672 (COO-1105-177) EVALUATION OF THE UDT-500 PHOTODIODE-OPERATIONAL AMPLIFIER PAIR AS DETECTOR FOR THERMOLUMINESCENCE. Au, Yue-Fan; Moran, P. R. (Wisconsin Univ., Madison. Dept. of Physics). [nd]. 19p. Dep. NTIS.

Limiting sensitivities and general properties of the UDT-500 photodiode–operational amplifier (United Detector Technology, Inc., Santa Monica, California) as a thermoluminescence readout detector were studied. It was found that there are different limitations in using the UDT-500 for TL detection, especially at low light levels where one must use the AC technique. Thus it does not appear very encouraging to use the photodiode for TL detection except for high exposure levels. There we can use the DC method that simplifies the set-up. In that case the photodiode is clearly superior to the PMT in range of linearity, tolerating high light level, ruggedness, and long-term gain stability. (W.H.K.)

50673 (EUR-4810(Vol.1)) THIRD SYMPOSIUM ON MICRODOSIMETRY, STRESA (ITALY), OCTOBER 18–22, 1971. Ebert, H. G. (ed.) (European Communities, Luxembourg. Commission). Feb 1972. 478p. (In several languages). (CONF-711028-(Vol.1)). EUR FB 1,000.

Separate abstracts were prepared on 25 papers presented at this symposium. (C.H.)

For abstracts of individual papers see: 50327, 50640, 50674, 50801–50804, 50816, 50821, 50835, 50856, 50920, 50921, 50966, 50967, and 52211–52220.

50674 (EUR-4810(Vol.1), pp 199-215) LET EFFECTS IN 1-HIT DETECTORS. A. RADICAL PRODUCTION IN SOLID BIOLOGICAL SUBSTANCES. B. THE FRICKE DOSIMETER. Katz, Robert; Sharma, S. C.; Homayoonfar, M. (Univ. of Nebraska, Lincoln).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The 1-hit model of detector response, originally developed to explain the response of dry enzymes and viruses to heavy ions, has now been shown to have quite general applicability to nuclear emulsions, scintillation counters, solid state dosimeters, as well as to free radical production in solid biological substances and to the Fricke dosimeter. In all cases the detector response is characterized by two macroscopic, operational parameters, the D-37 dose for gamma-rays, which suffices to describe both gamma-ray response and the response to heavy ions at high LET, and the radius of the sensitive element, needed to extend the description to radiation of low LET, in the grain-count regime. In all cases the response declines with increasing values of the LET of the incident radiation, is multiple-valued, and is non-linear in LET, becoming more pronounced in these characteristics as the D-37 dose decreases. The Fricke dosimeter displays a response which is similar to that of scintillation counters, raising the question as to similarity in the mode of energy transfer in aqueous solutions and in alkali halide crystals. The variation in the response of the Fricke dosimeter with LET may be characterized by the assumption that the chemical processes play themselves out in a way that is predetermined by the effects taking place in a sensitive volume of 60Å radius, and D-37 = 5×10^7 erg/cm^3, for the aerated dosimeter. The production of radicals in solid biological substances with radiations of different LET is also described by the same theory, developed for the explanation of the inactivation of dry enzymes and viruses, but the value of the D-37 dose for radical formation is two orders of magnitude less than that required for inactivation, for Trypsin, suggesting that radical formation is not the cause of inactivation in dry Trypsin. (auth)

50675 (IFA-PN-24) APPLICATION OF CELLULOSE NITRATE IN FAST-NEUTRON DOSIMETRY. Dragu, A.; Nicolae, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1971. 25p. (In French). Dep. NTIS (U. S. Sales Only).

A systematic study was made of the use of cellulose nitrate for the dosimetry of fast neutrons. The principle of solid detectors and the theoretical limit of their sensitivity are studied. The registration characteristics of the detector were determined. The experimental results led to the conclusion that the cellulose nitrate detector can be used for the dosimetry of fast neutrons by the utilization of elastic scattering on C, N, and O and also using (n,α) reactions. The recoil nucleus method is not suitable for dosimetry. In comparison with nuclear emulsions, the cellulose nitrate detector is more convenient and easier to use. (J.S.R.)

50676 (RD/B/N-2368) IRRADIATION OF TLD LiF AT ELEVATED TEMPERATURES. Tobias, A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jun 1972. 12p. Dep. NTIS (U. S. Sales Only).

TLD LiF extruded dosimeters were irradiated for periods of 1 hour at elevated temperatures in order to assess their use for radiation measurements in reactor environment at shutdown, when temperatures of 150 to 200°C are possible. For irradiation at temperatures up to 100°C, a slight increase in response of the dosimeters with increasing temperature was observed. This could be accounted for by a simple model proposed by other investigators. It is possible that the effect could be reduced by a careful pre-irradiation annealing procedure. The fading of signal can be estimated quite accurately for temperatures >100°C using the Randall–Wilkins single trap theory and values of 1.25 eV and 8×10^{11} s^{-1} for trap depth and frequency factor respectively. In measurements where the temperature cannot be measured, suitable cooling will be necessary. (auth)

50677 VOPROSY DOZIMETRII I ZASHCHITY OF IZLUCHENII. VYPUSK 11. (Problems of Dosimetry and Radiation Protection. Number 11). Kimel, L. R. (ed.). Moscow; Atomizdat (1970). 200p.

Questions of dosimetry, radiometry, spectrometry, and protection against radiation are considered. The articles were written on the basis of work done primarily at the Moscow Engineering Physics Institute, and finished by the middle of 1969. (102 figures, 21 tables, 245 references) (R.W.R.)

50678 THERMOLUMINESCENCE OF PLASTICALLY DEFORMED LiF(TLD 100). Petralia, S. (Univ., Bologna); Gnani, G. Lett. Nuovo Cim.; 4: No. 11, 483-6(15 Jul 1972).

A preliminary study on the effects of plastic deformation on the glow peaks of LiF thermoluminescent dosimeters is given. TLD-100 crystals were kept in an argon atmosphere at 400°C for an hour, quickly quenched to 0°C, and then pressed in a vice until the thickness was reduced from 3 to 9%. Peak 1 of the glowcure was increased and peak 5 was decreased by the crystal deformation. A model for the physical processes that describe this phenomenon is briefly discussed. (W.H.K.)

50679 USE OF CONCENTRATED AQUEOUS SOLUTIONS OF AMMONIUM NITRATE WITH ADDITIONS OF METHANOL FOR DETERMINING γ-RADIATION DOSES UP TO 6.10^8 rad. Zhestkova, T. P.; Pilaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 1, 78-9(1972).

Translated from Khim. Vys. Energ.; 6: No. 1, 92-3(1972).

The use of concentrated aqueous solutions of ammonium nitrate with additions of methanol for measuring absorbed doses of γ radiation of ^{60}Co to about 6×10^8 rad was investigated. The dependence of the quantity of decomposed NH$_4^+$ ions on the concentration of methanol and radiation dose rate is noted. (J.G.B.)

50680 DOSIMETRY OF ^{252}Cf. Robertson, J. S.; Fairchild, R. G.; Atkins, H. L. (Brookhaven National Lab., Upton, N. Y.). Radiology; 104: No. 2, 393-8(Aug 1972).

Methods to measure the dose rates of ^{252}Cf sources are described and the results of the measurements are presented. A computer program, using empirical constants based on the measurements, calculated the dose rates for arrays of ^{252}Cf sources and for 1.5, 2.0, and 3.0 cm linear sources. A Paterson–Parker type graph for use with ^{252}Cf surface applicators is included. (auth)

50681 METHOD FOR THE QUANTITATIVE ANALYSIS OF IONIZING RADIATIONS: A COLOR DOSIMETER. Bourderau, Emile (to Societe Kodak-Pathe). French Patent 2,077,659. 5 Nov 1971. Filed 3 Feb 1970. (In French).

Emulsions of different photosensitivity were exposed to ionizing radiations in order to determine quantitatively the characteristics of these radiations. After exposure, each of these emulsions was processed in a special way in order to modify the spectral absorption exposure characteristics. The characteristics of each emulsion and their processing treatments were chosen so that the spectral absorption characteristics were different. Exposures between 20 mR and 1000 R are considered. The photographic dosimetry developed for the quantitative determination of the characteristics of these radiations consists of at least two layers of Ag halide emulsion having adjacent or partially overlapping responses. (France)

50682 DOSE-DEPENDENT SENSITIVITY OF LiF-DETECTORS CONSIDERING THE POLARIZATION EFFECT WITH HIGH-ENERGY ELECTRONS. Degner, W.; Hegewald, H.; Windelband, R. (Humboldt-Univ., Berlin). Radiobiol.-Radiother.; 13: No. 3, 355-65(1972). (In German).

The same relative energy dependence of the output of a LiF solid state dosimeter was found if it had the calculated conversion factor (absorbed dose/ion dose). With it a reading is obtained by the LiF dosimeter in the considered energy region which is independent of the electron energy and proportional to the absorbed dose in the tissue. The dose-independent sensitivity for different types and energies of radiation is regarded as an important criterion. As opposed to the results with older detectors, different dose-dependent changes of sensitivity for different energies and types of radiation could not be demonstrated. (8 figures, 2 tables) (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 50727, 50741–50744, 51181, 51982, 52032, and 52634.

50683 (AD-737625) ELECTRON SPECTROSCOPY WITH SILICON SURFACE-BARRIER DETECTORS AT LIQUID HELIUM TEMPERATURES. Technical Report, July 1–December 31, 1971. Barr, Kevin P.; Sapp, Richard C.; Tarvin, John T. (Kansas Univ., Lawrence. Dept. of Physics and Astronomy). 1 Feb 1972. Contract Nonr-2775(00). 22p. NTIS.

In connection with the development of apparatus for the study of beta-radiations with energies of up to 500 keV from nuclei oriented at dilution refrigerator temperatures, four commercial silicon surface barrier detectors were tested for resolution as a function of temperature and applied bias. Resolutions of 8 keV (FWHM) at liquid helium temperatures were obtained at only 20 V bias. Problems with reliability and breakup of the aluminum back surface, as well as subsequent repair, are discussed, and comparisons are made to other work using cooled semiconductor detectors for beta-spectroscopy. (auth) (GRA)

50684 (CEA-R-4316) CONTRIBUTION TO THE STUDY OF GERMANIUM SEMICONDUCTOR DETECTORS IN GAMMA RAY SPECTROSCOPY. SIMULATION OF THE ENERGY SPECTRA AND CALCULATION OF THE EFFICIENCIES BY MONTE CARLO METHODS. Adam, Daniele (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Jun 1972. 66p. (In French). Dep. NTIS (U. S. Sales Only).

The efficiencies of germanium semiconductor detectors are calculated by Monte Carlo methods in the range from a hundred keV to 2 MeV gamma ray source energy and for different detector forms and volumes. Compared to other works, simplification is obtained in the simulation of secondary electrons. Whole simulated pulse heights distributions give good accordance with experimental spectra. (auth)

50685 (CEA-R-4355) IMPROVEMENTS IN THE STUDY OF TEMPORAL INFORMATION SAMPLING IN NUCLEAR SPECTROMETRY. Deroche, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jul 1972. 126p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Orsay, France.

The sampling of temporal information was studied by observing the signals produced at the output of planar Li compensated germanium P.I.N. detectors in gamma ray spectrometry. Fluctuations in the form of the signals are the most important source of error in the estimation of the instant of arrival of the radiations. Errors of this type were overcome by making the detection threshold as low as possible, i.e. at a level where noise produces frequent triggering. The noise problem which subsequently arises is resolved by the use of a time discrimination applied to both the signal and the noise. The time discriminator studied consists of a delay system which only transmits the temporal information when the duration of the signal above the threshold is greater than the delay of the system. From the point of view of time precision, the time duration discriminator leads to characteristics, which compare favorably with the best sampling systems in current use. In addition this system has the advantage of working at lower energies and having a smaller recovery time. The simplicity of the construction and the adjustment facilities are a further advantage of this system. (auth)

50686 (CONF-720824-1) NONDESTRUCTIVE DETERMINATION OF RADIONUCLIDES IN LUNAR SAMPLES USING A LARGE LOW-BACKGROUND GAMMA-RAY SPECTROMETER AND A NOVEL APPLICATION OF LEAST-SQUARES FITTING. Eldridge, J. S.; O'Kelley, G. D.; Northcutt, K. J. (Oak Ridge National Lab., Tenn.); Schonfeld, E. (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). 1972. 8p. Dep. NTIS.

From 1st international Summer school on radionuclide metrology; Herceg Novi, Yugoslavia (21 Aug 1972).

Dual-parameter gamma-ray spectrometer systems with large-volume NaI(Tl) crystals and ultra-low backgrounds have been used for the non-destructive determination of K, Th, U, and cosmic-ray produced radionuclides in 60 lunar samples. The total weight of samples measured with these systems is $\sim$28 kg, and the individual sample weights varied from 2 to 2300 g. Samples from Apollo 11, 12, 14, 15, and 16 missions have been measured. Operation of the spectrometers in a coincidence mode and analyzing singles- and coincidence-spectra permits the simultaneous determination of 8 to 10 radionuclides in each lunar sample. (auth)

50687 (EUR-4835) TIMECODER FOR NEUTRON TIME-OF-FLIGHT EXPERIMENTS. De Jonge, S. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center) May 1972. 20p. Dep. NTIS (U. S. Sales Only).

The described timecoder is designed for neutron time-of-flight experiments at the linear accelerator of the CBNM at Geel, Belgium. By the use of MECL II integrated circuits it features simple design and low cost. Basic channelwidth is 40 ns, which can be multiplied in 8 succeeding regions with a factor of 1 to 99, which may be different for each region. In regions where no events have to be stored, address counting is inhibited which results in optimal use of the 4096 output channels (12 bits). The deadtime of the coder together with a buffer memory is 280 ns, permitting several events to be registered during one measurement cycle. (auth)

50688 (LCA-NT-191/ET) PROCESSING OF GAMMA SPECTRA: JUNCTION DETECTOR. Vesque, Jacques (Laboratoire Central de L'Armement, Arcueil (France)). 25 Nov 1971. 40p. (In French). Dep. NTIS (U. S. Sales Only).

The SPG program replaces the assembly of programs: LILI2; LILI3; LILI4. This program is very different from the others, and involves improvements in the treatment of spectral data: the low intensity peaks and the multiplets are processed during the automatic searching for the peaks; the method of minimization adopted during the fitting phase (mean squares) is of high efficiency. Unfortunately it was not possible to reduce the calculation time. Various different spectra were treated by SPG. The program gives good results if the different adjustments are correctly chosen (ILISSA, NPOINT, IACRI). SPG does not interpret the data but fits it. In order to determine the different nuclides present in a mixture, it is necessary to utilize an adjoining calibration subprogram to convert the channel positions into energy positions. (France)

50689 (RDT-C-14-3-T(7-72)) GAMMA-RAY SPECTROMETER-COMPUTER SYSTEM. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1972. 24p.

A standard specifying the requirements for the design, performance, fabrication, quality assurance, examination, and acceptance testing of a gamma-ray spectrometer-computer system, subsystems, and components for monitoring radioactivity is given. The system will have the capability of monitoring several radioactive gas streams including the reactor primary cover gas, gas from a sodium sparging unit, and other fluids. (W.H.K.)

50690 ANALYSIS OF CdTe AS A γ-RAY SPECTROMETER. Zanio, K.; Akutagawa, W. (Hughes Research Labs., Malibu, Calif.). Appl. Phys. Lett.; 10: No. 8, 294-6(15 Apr 1972).

Gamma spectra were taken at room temperature with devices fabricated from semi-insulating CdTe. A resolution of 8 keV (FWHM) was found for ^{241}Am (60 keV), 10 keV for ^{57}Co (122 keV), 30 keV for ^{137}Cs (662 keV), and 75 keV for ^{60}Co (1.33 MeV). The photoelectric absorption coefficient at a photon energy of 122 keV was measured to be 5.4 ± 0.4 cm^{-1} in CdTe. The escape of the photoelectron at higher photon energies degraded the spectra and lowered the absorption coefficient below their theoretical values. Devices were also encapsulated within probes and their efficiency to photoelectric events was compared with that of a silicon detector. Ratios of 150 : 1 for ^{57}Co and 12 : 1 for ^{241}Am were found favoring CdTe. (auth)

50691 PHYSICAL ANALYSES FOLLOWING A NUCLEAR ACCIDENT. Huber, D. (Univ., Fribourg, Switzerland). Strahlenschutz Forsch. Prax.; 11: 21-9(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

For the rapid analysis of an accident mixture for the evaluation of an accident situation, γ spectroscopy with high-resolution Ge(Li) semiconductor counters has come to the front. Decay schemes, measuring apparatus, calibration, and calculation method are briefly discussed. The analyses of a fresh fallout mixture and of mixtures after the accident in Lucens are cited as typical applications. (6 figures, 2 tables) (INIS)

50692 TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK IV. (Proceedings of the Union Research Institute of Instrument Construction. Issue IV). Matveev, V. V. (ed.). Moscow; Atomizdat (1967). 112p.

In 1967 this publication became a semiannual, with 18 papers represented in this issue. Semiconductor detector application to x and nuclear radiation was the subject of several articles. The properties of single crystals of ZnS were studied for use of the material in scintillators. The spectrometer "Amur" was employed in the determination of the isotopic composition of uranium and also for control of semiconductor detector parameters during their fabrication. A review article discusses the stabilization of the measuring characteristics of spectrometric apparatus (26 references). Four papers consider various modifications of memory devices. The nuclear reactions D(d,n)^{3}He and T(d,n)^{4}He found use in the calibration of fast neutron radiometers, and in the determination of yield at energies of 100 keV with thick targets. Positron annihilation in an ultrahigh frequency discharge was studied. A critique of the terminology current in the field of ionizing radiation is offered. (K.S.W.)

High Energy Physics Instrumentation

Refer also to abstract 51917.

50693 (BNL-16841) INSTRUMENT FOR THE MEASUREMENT OF LARGE TOTAL TRANSVERSE MOMENTUM: THE IMPACTOMETER. Willis, W. J. (Brookhaven National Lab., Upton, N. Y.). 3 Mar 1972. 30p. Dep. NTIS.

A detector system for measuring the total hadron transverse momentum, the hadron vector momentum, and the total hadron energy in high-energy beam–beam collision interactions is described. Several e + p and p + p colliding beam interactions which might be relevant to studies of large transverse momenta and measured by the detector system are discussed. The detector system is based on arrays of ionization calorimeters (such as iron–scintillator sandwich detectors) covering the whole solid angle except for small holes for the passage of beams. Variations of the design using position-sensitive proportional wire chambers or scintillation counter hodoscopes are discussed. Electron and hadron discrimination and muon identification should be good. The flexibility and experimental possibilities of the system are described. (W.H.K.)

50694 (BNL-16842) IMPLEMENTATION OF AN EXPERIMENTAL PROGRAM AT THE BNL ELECTRON-PROTON COLLIDING BEAM FACILITY. Marx, Jay; London, Georges W. (Brookhaven National Lab., Upton, N. Y.). 7 Mar 1972. 15p. Dep. NTIS.

The ep option can be an important addition to the ISABELLE project, as it assures the ability to study weak and electromagnetic processes at very high energies in the absence of hadronic background. A possible experimental program, which is well matched to a 4π solid angle detector facility, has been suggested. A possible detector for this purpose is the Impactometer, essentially a 2-m collinear interaction region surrounded with total absorption calorimeters, multiwire proportional chambers, wire spark chambers, and scintillation counters. It is suggested that such a device be viewed as a first-generation survey instrument and facility in view of its high cost ($1.7M) and wide utility. Such a device is best allocated to its own intersection region in the unused straight section. (4 figures, 3 tables) (R.W.R.)

50695 (CERN-72-9) ANALYSIS OF THE MECHANISMS OF THE FORMATION OF STREAMERS. Bayle, P.; Schmied, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 31 May 1972. 32p. (In French). Dep. NTIS (U. S. Sales Only).

The principal results obtained from studies on the formation mechanisms of the avalanche and streamer in hydrogen are compiled. The results obtained by simulating numerically the formation of the streamer in hydrogen are reported. The continuity equations governing the evolution of the electron and ion densities are resolved numerically by taking into account the effects of space charge and secondary electron effects. It is shown how, for hydrogen—organic vapor mixtures, the absorbant role of the vapor can reduce certain secondary effects and limit the spatial extension of the discharge. (tr-auth)

50696 (COO-1195-228) SOME SOFTWARE TECHNIQUES FOR THE DOLLY SYSTEM. Brown, Richard M.; Wray, Jerald J. (Illinois Univ., Urbana). Nov 1971. 13p. (CONF-720116-1). Dep. NTIS.

From Informal conference on polly and polly-like devices; Argonne, IL. (11 Jan 1972).

The use of histogram techniques for pattern recognition and filtering is discussed. Also described is an interpretive sequencer used to control both complex measuring sequences and detailed scanning procedures. (auth)

50697 (JINR-P13-6513) STUDY OF TRACK FORMATION OF IONIZING PARTICLES IN ULTRASONIC FIELD IN LIQUID HYDROGEN BUBBLE CHAMBER. Akulichev, V. A.; Grebinnik, V. G.; Zhukov, V. A.; Krasil'nikov, V. A.; Manych, A. P.; Selivanov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

Results are presented of an experimental study of the track formation of ionizing particles in a liquid hydrogen bubble chamber where overheating of the working liquid was performed by joint action of a system of ultrasonic emitters, exciting the standing waves with the frequency of 50 kGs, and an expansion system of an ordinary type. The dependences of the size of bubbles on the ultrasonic pressure and on the static pressure in the liquid were obtained. It was found that, when exciting strong ultrasonic fields in liquid hydrogen, on the emitter surface there appears parasitic boiling (cavitation) which limits the value of the ultrasonic wave pressure and affects the track formation of ionizing particles. The possibilities are discussed of creation of ultrasonic bubble chambers and their application in high-energy physics. (auth)

50698 (JINR-P13-6533) HIGH-VOLTAGE PULSE GENERATORS FOR STREAMER CHAMBERS. Kulyukin, M. M.; Pontekorvo, D. B.; Soroko, V. M.; Falomkin, I. V.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The characteristics and specific features of developed pulse generators are described. The necessary requirements for operation of the pulse generators for streamer chambers are formulated. (auth)

50699 (SLAC-PUB-1056) MULTIPARTICLE SPECTROMETER FOR VERY HIGH INTENSITY CHARGED PARTICLE BEAMS. Martin, F. (Stanford Linear Accelerator Center, Calif.). Jun 1972. 3p. (CONF-720409-13). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

A spectrometer developed at SLAC for analyzing multiparticle final states in the $e + p \rightarrow e + p + m\pi$ interactions is briefly described. The central feature of the spectrometer is a superconducting tube which creates a field-free region in the magnet and spark chambers so that the electron beam can pass undeflected through the equipment without causing excessive background problems. The electron beam strikes a target upbeam of the magnet and passes through the superconducting tube into a quantameter behind the detectors. The particles from an inelastic collision pass outside the tube through the magnetic field and into the detectors which consist of optical spark chambers and counters. (W.H.K.

50700 SPECTROMETRY OF HIGH ENERGY PHOTONS AND ELECTRONS WITH SPARK CHAMBERS. Gapotchenko, A. G.; Govorkov, B. B.; Denisov, S. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 208-23(1971). (In Russian).

Results with multiple spark chambers as spectrometers for 50- to 200-MeV electrons and photons are presented, and the characteristics of electromagnetic showers in a chamber with Pb plates were studied. A multilayer spark chamber with Plexiglas plates was used as a spectrometer for electrons and photons with an energy resolution of 35%. (tr-auth)

50701 NEW IDEAS IN THE FIELD OF TRACK CHAMBERS. Pisarev, A. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 650-87(1972). (In Russian).

The problems are surveyed of developing new fast devices of various types: ultrasonic bubble chambers, chambers filled with oversaturated binary solutions and gassed overcooled liquids, chambers based on the gas-vapor discharge, wire counters and wire chambers filled with condensed media, liquid and solid-state chambers based on scintillation and fluorescence as well as the mechanism of charge multiplication in condensed media, and discharge and condensing chambers containing pure dense gas and gas mixtures. The present day state of studies on the above problems is analysed and the promising ideas in this region are considered. (auth)

50702 MIRABELLE AT SERPUKHOV. Sulyaev, R. Phys. Bull. (London); 23: 395-6(Jul 1972).

Mirabelle, the 11 m^3 liquid hydrogen bubble chamber built at Saclay and transferred to Serpukhov, is described. The cooling system, expansion system, and photographic system are briefly discussed. (W.H.K.)

Radiometric Instruments

Refer also to abstracts 50214, 50252, 50514, 50517—50521, 50617, 50723, 50754, and 50778.

50703 (AEC-tr-7138, pp 26-32) ON THE ERROR AND SENSITIVITY OF DENSITY AND THICKNESS MEASUREMENTS BY RADIOISOTOPE ABSORPTION-MEASUREMENT TECHNIQUES. Kreindlin, I. I.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

The effects of multiple scattering of gamma quanta is allowed for by the buildup factor, which is used in the form of an expression containing one exponential term. A binary mixture is assumed. Since measurements are carried out within a given range of densities, it is possible to select a given (fixed) gamma flux. An expression is obtained for the sensitivity of the method (change in flux caused by changes in the density of the medium). Fluctuations in the gamma flux cause random errors in the reading of the apparatus even though the density of the medium remains constant; this limits the sensitivity of the apparatus. Because the expression obtained for the error associated with the statistical nature of radiation contains a term for the range of measured densities, the nature of the optimum parameters in solving the great majority of problems is changed markedly from the usual situation. The instrument error is determined by both statistical fluctuations and instrument instability; since instrument errors are usually relative, there is no optimum in the error expression. The results indicate that there are no practically acceptable optimum conditions, with respect to sensitivity and error, for radiation-absorption techniques used in density and thickness measurements because of both statistical fluctuation and instrument errors. The sensitivity may be increased and the error reduced by stabilizing the working apparatus; increasing the probe sensitivity, the time of measurement, and the radiation path length; and by the selection of the "softest" possible radiation sources (which would mean, of course, using sources of higher strength). (1 figure) (R.W.R.)

50704 (AEC-tr-7138, pp 40-5) OPTIMUM SELECTION OF RADIATION SOURCES AND PROBES FOR RADIOISOTOPE INSTRUMENTS. Kreindlin, I. I.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

A number of considerations come into play in choosing radiation sources and detectors for a radiometric instrument; these include size, weight, cost, accuracy, safety regulations, etc. Methods for finding the optimum combination are discussed, the simplest and most effective solution of the problem usually being by the method of excess variations. The procedure is illustrated for the problem of measuring the density of HNO_3 under several different sets of constraints. (1 table) (R.W.R.)

50705 (AEC-tr-7138, pp 45-50) MEASUREMENT OF COATING THICKNESS OVER SMALL AREAS BY THE METHOD OF BACK-SCATTERED BETA RADIATION. Pravikov, A. A. Translated from Radiats. Tekh.; No. 3, (1969).

Difficulties associated with the measurement of small areas are discussed, in particular, the gamma background. Equations used in beta-backscatter measurements are rederived with the gamma background taken into account. Those factors that cause an increase in the measurement error can be considered as an increase (impairment) in the geometrical factor. Application of the equations derived is illustrated with an example. (R.W.R.)

50706 (AEC-tr-7138, pp 51-5) ON THE TRANSFORMATION OF SPECTRA OF BETA SOURCES USED IN COATING THICKNESS MEASUREMENTS BY THE METHOD OF BACK-SCATTERED RADIATION. Pravikov, A. A.; Boyarova, A. K. Translated from Radiats. Tekh.; No. 3, (1969).

It has been shown that in beta-backscatter measurements each nuclide used as a beta source corresponds to a certain range of measurements in which the relative and absolute errors are minimum. In view of the relatively limited number of beta emitters and the advantages of using a single source for the separate measurement of two-layer coating thicknesses, it is of interest to examine the possibility of transforming the energy spectrum of beta particles emitted from the source, i.e., of shifting the spectrum to a region that provides the minimum error of measurement. This can be done by using absorbing filters of various thicknesses. The changes in the scattering coefficient and the number of beta particles when the radiation passes through a filter are analyzed. One of the most important problems encountered is the reduction in the number of beta particles caused by the filtration: for a typical case, in which a ^{90}Sr$-^{90}$Y source was transformed to the equivalent ^{204}Tl source, the number of utilized beta particles decreased by a factor of 100. (3 figures) (R.W.R.)

50707 (AEC-tr-7138, pp 55-9) COMPARISON BETWEEN RADIOMETRIC LEVEL-GAUGING METHODS. Kukharenko, I. V.; Mashinin, V. A.; Shipulina, L. A. Translated from Radiats. Tekh.; No. 3, (1969).

There are a number of different configurations for radiometric gages; some of these were compared on the basis of their accuracy parameters. It was found that the best accuracy is achieved with tracing-type level gages with moving source and detector. Level gages with a moving detector (but not source) are also useful for tanks that are not too high. For low containers several other types can be profitably used. (3 figures, 2 tables) (R.W.R.)

50708 (AEC-tr-7138, pp 101-12) USE OF BACK-SCATTERED GAMMA RADIATION FOR THE MEASUREMENT OF LOW ALTITUDES. Serebrennikov, I. Ya.; Ostretsov, L. A.; Fradkin, G. M.; Kodyukov, V. M. Translated from Radiats. Tekh.; No. 3, (1969).

Theoretical basis for a gamma backscatter altimeter is laid first. The combined effects of the radiation reflected from the earth and the radiation scattered in the air lead to a very complicated function of altitude for the count rate. The experimental part of the work included laboratory studies on an altitude test bed, preparation of a prototype, and testing of the latter by means of a helicopter. The results indicated that it is possible to develop altimeters for the measurement of low altitudes by using backscattered gamma radiation. (10 figures, 1 table) (R.W.R.)

50709 (AEC-tr-7138, pp 138-42) SOME POSSIBILITIES OF EXTENDING THE UPPER LIMIT OF THICKNESS MEASUREMENTS BY THE GAMMA REFLECTION METHOD. Kreindlin, I. I.; Skoblo, Yu. A. Translated from Radiats. Tekh.; No. 3, (1969).

Methods for increasing the maximum thickness that can be measured by using a commercially available gamma reflection gage are discussed. These include increasing the time constant of the count-rate meter and modification of the counter head. Use of all the procedures suggested can double the maximum thickness. (6 figures) (R.W.R.)

50710 (AEC-tr-7138, pp 112-21) EFFECT OF DENSITY OF THE MEDIUM ON THE ACCURACY OF HEIGHT AND LEVEL MEASUREMENTS MADE WITH THE AID OF BACK-SCATTERED GAMMA RADIATION. Bulatov, B. P.; Serebrennikov, I. Ya. Translated from Radiats. Tekh.; No. 3, (1969).

It is shown that, if a detector recording the backscattered gamma radiation is placed at distances $\lesssim$ the mean free path length of primary radiation quanta in the reflecting material, the intensity of scattered radiation may depend on the density of the reflecting medium. In detecting gamma radiation from a plane unidirectional source, backscattered by infinite plane reflectors, the buildup factor upon reflection does not depend on the density of the scattering medium. Experiments show that scattered gamma radiation from a narrow beam of primary radiation seems to be emitted from a certain effective region at some depth in the scattering medium, and a change in the density (as well as in the atomic number) of the medium shifts that region to some depth in the reflector. The anisotropy in the angular distributions of the intensity of scattered radiation is determined by the combined effect of two competing processes—the increase in the hardness and probability of scattering of secondary photons with decreasing scattering angle and the increase in the path of scattered radiation in the material. The results obtained may be used for a more accurate calculation of the density effect of the reflector material on the error in measuring the distance to its surface by the gamma backscatter method. (7 figures) (R.W.R.)

50711 (AEC-tr-7138, pp 230-6) DETERMINATION OF THE TECHNICAL-ECONOMIC FEASIBILITY OF INTRODUCING THE URMS-2 APPARATUS IN THE AUTOMATIC CONTROL SYSTEM OF A BLAST FURNACE. Smirnova, Z.; Purtova, M. I. Translated from Radiats. Tekh.; No. 3, (1969).

The URMS-2 is a radioisotopic scanning level gage widely used in blast furnaces in metallurgical plants for the automatic control and monitoring of the level of granulated charges. A study undertaken to determine the economic feasibility of using these instruments and the economic and technical effects of their use is described. The results of the technical-economic study and calculations of the economic feasibility confirm the usefulness (and necessity for blast furnaces with volumes from 700 to 2000 m^3) of employing radioisotopic scanning level gages for the automatic monitoring and regulation of the level of the charge materials. (L.C.L.)

50712 (EGG-1183-1557) AERIAL SNOW GAUGING USING NATURAL TERRESTRIAL GAMMA RADIATION. Fritzsche, A. E.; Burson, Z. G. (EG and G, Inc., Las Vegas, Nev.). Aug 1972. 21p. (CONF-720805-2). Dep. NTIS.

From second conference on natural radiation environment; Houston, TX. (7 Aug 1972).

Aerial snow gaging using the transmitted terrain gamma radiation has been shown to be practical. The accuracy of about 10% is expected to improve as techniques for evaluating airborne radon-daughter contributions are developed and as the peak area extraction from spectral data is perfected. Both the gross count and peak area techniques illustrated will provide this accuracy. (auth)

50713 (INR-P-1404) ANALYSIS OF SURFACE LAYERS BY ELASTIC BACKSCATTERING. **Turos, Andrzej; Wielunski, Leszek (Institute of Nuclear Research, Warsaw (Poland)). 1972. 22p. Dep. NTIS (U. S. Sales Only).**

A method for the analysis of surface layers by elastic backscattering of low energy heavy charged particles is described. This method allows the determination of the thickness of thin films and surface layers, as well as the identification of elements which are present in the investigated target. The total amount of a given kind of nuclei in a surface region may also be evaluated. Presented applications of the backscattering technique to some typical cases indicate the usefulness of the method. (auth)

50714 INVESTIGATIONS OF THE MELTS OF THE ALUMINUM INDUSTRY BY GAMMA-RADIATION. **Aradi, Antal; Balazs, Endre. Femip. Kut. Intez. Kozlem; 10: 89-97(1971). (In Hungarian).**

A method is described for the determination of density by radiation absorption, based on the gamma radiation absorption of the materials. The experiments of Beljajev were further developed by increasing the sensitivity of the recording instrument, by computing the optimal geometry, and by reducing the error limit. Calibration measurements were carried out with the instrument in order to determine the density of aluminum, as well as that of cryolite–alumina melts. Results obtained showed good agreement with data in the literature. Similarly, the density of molten anode alloys and refining baths was determined. Results were in good agreement with one another, and rendered the correction of the usual computing formula possible, on the one hand, by correcting the constant member of the formula, and on the other, by computing the temperature gradient of the density. (3 figures, 3 tables) (auth)

50715 ISOTOPE GAGES: ERRORS IN HOT-METAL-THICKNESS MEASUREMENT. **Raaen, Helen P. Isotop. Radiat. Technol.; 9: No. 4, 405-7(1972).**

Three sources of error in the measurement of the thickness of hot metals with isotope gages are considered theoretically including metal composition, temperature, and statistical variations. An artifice is proposed which may overcome some of the limitations. (auth)

50716 PRINCIPLES AND TECHNIQUES OF ALPHA-PARTICLE GAGING. Driscoll, E. J.; Crume, T. E.; Verghese, K.; Gardner, R. P. (North Carolina State Univ., Raleigh). Isotop. Radiat. Technol.; 9: No. 4, 460-6(1972).

Alpha particle gaging is categorized and discussed on the basis of (1) transmission, (2) elastic scattering, and (3) interaction effects. Gaging techniques and research and development work are described. (77 references) (W.H.K.)

50717 USE OF RADIOISOTOPE METERS IN THE COAL MINING INDUSTRY OF THE UKRAINE. Tsymlov, D. M. (Scientific Research Inst. for Isotope Handling Equipment, Riga); Golovan, A. S. Isotopenpraxis; 8: No. 2, 70-1(Feb 1972). (In German).

The number of radioisotope meters in use in the coal mining industry of the Ukraine is tabulated. The economic advantages of their use is shown. (J.S.R.)

50718 BULK DENSITY GAGE AND BULK DENSITY CONTROL SYSTEM. Reim, Thomas E.; Pollack, Jerry J.; Kemmerling, Robert A. (to Republic Steel Corp.). U. S. Patent 3,678,268. 18 Jul 1972. Filed 5 Nov 1970.

The output of a radioactive source is directed through a moving stream of granular material, e.g., coal on a conveyor, and the radiation passing through is sensed by a detector. The detector generates a pulse signal of which the pulse repetition rate varies with the radiation sensed. The pulses generated are counted in a binary counter, and a timer periodically initiates a read-out of and resets the counter to effect successive counting cycles, whereupon the digital count in each cycle is converted to an analog voltage, and magnitude of which is recorded in terms of bulk density of the coal. The recorder controls the addition of water or oil to the coal to, respectively, lower or increase the bulk density of the coal. Controls are included which guard the system for misperforming when a supply of coal has failed, when the depth of coal on the conveyor belt has been lost, and when the coal is so dense that an application of water is required. (auth)

50719 METHOD FOR MEASURING THE THICKNESS OF THIN FILMS UNDER VACUUM. Levenes, Guy (to Societe Industrielle de Combustible Nucleaire). French Patent 2,087,500. 6 Dec 1971. Filed 21 May 1970. (In French).

A method for measuring the thickness of thin films during their manufacture under vacuum is described. The β radiation reemitted from a reference film irradiated with a beam from a low-intensity source is measured during a short time interval. This reference film is obtained at the same time and under the same conditions as the film being manufactured. The thickness deposited under these conditions is determined from comparisons made with previous β-ray measurements made with reference films of known thickness. The device consists of a point radioactive source positioned near to a thin metallic (light-alloy) substrate upon which the deposit is made. A doped semiconductor layer is used as the detector. This apparatus can be used for backscattering or transmission measurements. (France)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

50720 (SC-DC-72288) SEMICONDUCTOR DEVICE DEGRADATION BY HIGH AMPLITUDE CURRENT PULSES. Brown, W. D. (Sandia Labs., Albuquerque, N. Mex.). Jul 1972. 33p. (CONF-720707-8). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

The results of a lengthy and comprehensive investigation of semiconductor device degradation from nanosecond current pulses induced in the circuit by gamma rays are presented. Topics discussed include (1) previously published literature on pulse degradation and second breakdown, (2) experimental results obtained in several studies, (3) pulse damage recovery using several annealing techniques, (4) a model of the pulse damage, (5) possible methods of hardening against pulse degradation, and (6) a preventive measure that can be taken to eliminate pulse damage. (auth)

50721 (SC-R-722845) NEUTRON IRRADIATION EFFECTS ON MICROWAVE TRANSISTOR AMPLIFIERS. Webb, J. G.; Chaffin, R. J. (Sandia Labs., Albuquerque, N. Mex.). Aug 1972. 6p. Dep. NTIS.

The effect of neutron fluence on the noise performance, power gain, and power output of microwave bipolar transistor amplifiers was studied. Low noise, small signal amplifiers and high efficiency, high power amplifiers were studied. It was found that microwave bipolar transistors are fairly insensitive to neutron damage in both low noise and high power applications and useful amplifier performance beyond 10^{15} nvt can be obtained. (W.H.K.)

50722 STIMULATED EMISSION FROM A RUBY LASER EXPOSED TO ^{60}Co γ RAYS. Bedilov, M. R.; Khaidarov, K. (Inst. of Nuclear Physics, Tashkent). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 311-13(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 391-4(Feb 1972).

A comprehensive study is described of the time, energy, and spectral properties of stimulated ruby laser emission, the radiation density distribution across the beam during one flash of the pumping lamp, and of the variation in absorption before and after exposure to ^{60}C γ rays. A 75-mm-long, 7.5-mm-diam. ruby rod doped with 0.05% Cr^{3+} is used in the experiments. Gamma rays with a flux intensity of 100 R/sec in dosages of 10^2, 10^4, and 10^6 R are used. The results indicate that dosages up to 10^6 R cause significant changes in stimulated laser emission which can be explained by reduced Cr^{3+} activator concentration. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 50494, 50507, 50524, 50604, 50661—50663, 50755, 51008, 51068, 51156, 51238, 51955, 51956, 52104, 52248, 52346, 52349, and 52631.

50723 (AEC-tr-7138, pp 121-30) RANDOM-NUMBER GENERATORS BASED ON THE USE OF RADIOACTIVE ISOTOPES. Varvaritsa, V. P.; Kozlov, L. F.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

Because certain disadvantages accrue to the use of programming or electronic noise to generate random numbers, the design of a random number generator employing a radioisotope is considered. The results of an experimental investigation of the main statistical characteristics of the numbers generated by such a device are presented, and the prospects for its use are assessed. The simplicity, high reliability, and low cost of radioisotope random number generators augur the future use of such devices. (7 figures, 1 table) (R.W.R.)

50724 (AEC-tr-7138, pp 130-7) USE OF RADIATION FROM RADIOACTIVE ISOTOPES IN THE MODELLING OF PROBLEMS OF QUEUEING AND RELIABILITY THEORY. Gusev, E. S.; Kozlov, L. F.; Matveev, L. V. Translated from Radiats. Tekh.; No. 3, (1969).

A generator of random time intervals employing a radioisotope is described, and the results of modeling of certain typical problems of queueing and of reliability theory obtained with the aid of the above generator are reported. For one such problem the relative error of the solution with the model did not exceed ± 7% as compared with an analytical solution of the problem. It was concluded that a model based on the use of radioisotopic simulators of random current pulses is simpler than the analogous model using simulators based on other principles. It is easily built with the aid of a small number of simple logic circuits and radioisotopic simulators of random current pulses. The model should be used to solve complex queueing problems when digital computers are unsuitable. (6 figures) (R.W.R.)

50725 (BNL-16823) SAWTOOTH VOLTAGE GENERATION FOR A POSSIBLE AGS BEAM BUNCHING PREPARATORY TO INJECTION INTO ISABELLE. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 9 Dec 1971. 11p. Dep. NTIS.

One method for transferring the beam from the AGS and stacking it in ISABELLE is to form a single beam bunch in the AGS, which is assembled in "box car" fashion in ISABELLE. One way to do this is to debunch the 12 beam bunches used in the AGS acceleration process adiabatically and rebunch into a single bunch with a sawtooth waveform. A ±5 kV sawtooth waveform produces a final beam stack with the desired characteristic in about 65 ms. The beam loading on the system is determined. Several methods for generating the desired waveform, using a hard tube modulator, summation of sine waves, and summation of "switched" sine waves, are considered; it is concluded that the "switched" sine wave method is simple and much easier to build than the others. Cavity design and supply source requirements are described. (4 figures) (R.W.R.)

50726 (BNL-16831) LARGE MAGNET SPECTROMETERS FOR ISABELLE. vonGoeler, E. (Brookhaven National Lab., Upton, N. Y.). 1 Feb 1972. 6p. Dep. NTIS.

The desirability of a large magnet spectrometer is discussed, and the design of such an instrument for ISABELLE is described. (2 figures) (R.W.R.)

50727 (CEA-R-4306) AN ELECTROSTATIC PARTICLE GUIDE (APPLICATION TO ELECTRON-CONVERSION SPECTROMETRY). Libs, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1972. 70p. (In French). Dep. NTIS (U. S. Sales Only).

An electrostatic device, which almost completely removes the gamma ray background from electron-conversion spectra, is described. In a number of cases, such a device is preferred to magnetic ones, because among other properties, it is cheaper and more flexible. The resolving power, depending chiefly on the detector performance but not on the electrostatic field strength, was found better than 1.5 keV with a cooled field effect transistor at the input stage. Several spectra show convincingly the advantages provided by this equipment. (auth)

50728 (COO-1105-174) WIDE TEMPERATURE RANGE APPARATUS FOR THERMALLY ACTIVATED EFFECTS; PRELIMINARY RESULTS ON THERMOLUMINESCENCE OF HYDROGEN-RICH SOLIDS. Podgorsak, Ervin; Moran, P. R. (Wisconsin Univ., Madison. Dept. of Physics). [nd]. 9p. Dep. NTIS.

The construction of a liquid nitrogen dewar and sample probe apparatus for a systematic study of radiation-induced effects in hydrogen-rich solids over an extended temperature range is described. As the sample can be heated by hot gas, the apparatus has a working temperature range of 77 to 550°K. Problems common to the hydrogen-rich materials themselves and spurious background signals are discussed. A typical TL glow curve of ADP after exposure at liquid nitrogen temperature of about 2000 R is shown. (4 figures) (R.W.R.)

50729 (IPP-9/5) AN IMPROVED RETARDING FIELD ANALYSER. Staib, P. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1972. 14p. Dep. NTIS (U. S. Sales Only).

A new electrostatic energy analyzer is presented. It uses two sets of spherical grids. The first one is a retarding field arrangement in which the particles are decelerated down to energies close to zero. The transmission properties of the retarding field are presented. The particles enter the second part, an inverted spherical accelerating set which sharply focusses the low energy particles into the entrance aperture of a multiplier, whereas the high energy part misses the aperture. By cutting out the fast part, only a narrow energy band reaches the detector and a high signal-to-noise ratio results. (auth)

50730 (LBL-772) USE OF SCATTERING PARAMETERS IN THE DESIGN OF AMPLIFIERS OF SUBNANOSECOND RISETIME. Wilson, Rosser S. (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1972. Contract W-7405-eng-48. 167p. Dep. NTIS.

Thesis.

Techniques useful in the design of wideband linear amplifiers intended for pulse operation are discussed. A suitable model for high-frequency transistors is given, and use is made of the scattering characterization and of a special computer program to deduce element values in the model. The design of a fast risetime series-shunt pair and series-series triple is carried out, and computer simulations are used to predict performance of the actual designs inclusive of all parasitic reactances consequent upon physical realization of the circuit. (auth)

50731 (ORNL-4734) INSTRUMENTATION AND CONTROLS DIVISION. Annual Progress Report for the Period Ending September 1, 1971. Sadowski, G. S. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 161p. Dep. NTIS.

- COMPUTERS—interfaces for, development at ORNL, 9/70–9/71
- CONTROL SYSTEMS—development of automatic, at ONRL, 9/70–9/71
- DATA ACQUISITION SYSTEMS—development at ORNL, 9/70–9/71
- DATA PROCESSING SYSTEMS—development at ORNL, 9/70–9/71
- ELECTRONIC EQUIPMENT—development at ORNL, 9/70–9/71
- IN-PILE LOOPS—instrumentation for, development at ORNL, 9/70–9/71
- INSTRUMENTS—development at ORNL, 9/70–9/71
- LINEAR ACCELERATORS—control systems and instruments for ORELA, development of, 9/70–9/71
- LIQUID METAL FAST BREEDER REACTOR—thermometry for, development at ORNL, 9/70–9/71
- PROCESS EQUIPMENT—development at ORNL, 9/70–9/71
- PULSE ANALYZERS—development at ORNL, 9/70–9/71
- RADIATION DETECTORS—development at ORNL, 9/70–9/71
- RADIATION MONITORING—instrumentation for, development at ORNL, 9/70–9/71
- REACTOR CONTROL SYSTEMS—development at ORNL, 9/70–9/71
- REACTOR SAFETY—research at ORNL, 9/70–9/71
- REACTORS—instrumentation for, development at ORNL, 9/70–9/71
- STANDARDS—development for reactor auxiliary and protection systems at ORNL, 9/70–9/71
- THERMOCOUPLES—development at ORNL, 9/70–9/71
- VAN de GRAAFF ACCELERATORS—instrumentation for, development at ORNL, 9/70–9/71 (R.W.R.)

50732 (ORNL-TM-3907) THERMAL CYCLING LIFE TESTS OF METAL SHEATHED THERMOCOUPLE ASSEMBLIES. Herskovitz, M. B. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 19p. Dep. NTIS.

Stainless steel clad, $\frac{1}{8}$-in.-OD MgO insulated Chromel/Alumel thermocouples were tested and evaluated for application in liquid-metal fast breeder reactors. In a first series of tests, nonirradiated units were thermally cycled by heating them to 1200°F, followed by cooling at 100°F/sec for 4 sec. In a second series, the upper temperature was increased to 1800°F and the cooling rate was doubled (200 to 250°F/sec for 4 sec). Both grounded-junction and insulated-junction units were thermally cycled until the thermoelectric conductors failed. At the lower temperatures and cooling rate, 12 insulated-junction thermocouples were cycled 15,000 times and 6 grounded-junction thermocouples were cycled 2600 times without failure. At the higher temperatures and cooling rates, the failure rate of grounded-junction thermocouples was about three times higher than that of insulated-junction thermocouples. (auth)

50733 (RD/B/N-2331) ELECTROCHEMICAL HYDROGEN CONCENTRATION CELL, WITH APPLICATION TO SODIUM SYSTEMS. Smith, C. A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1972. 23p. Dep. NTIS (U. S. Sales Only).

The variation of cell electromotive force with hydrogen gas pressure was studied for a hydride activated hydrogen concentration cell: $H_2(p_1)$ (Fe) $|$5m/0 CaH_2 in Ca $Cl_2$$|$ (Fe) H_2 (p_2). The emf was found to obey the expression: $E = E_0 + ART/2F$ 1m p_2/p_1 where $0 < E_0 < 5$ mV, and A is normally >0.95. The cell was used to measure hydrogen pressures in the range 2 atm to 0.05 torr at 500 to 600°C. The response of the cell to a stepwise hydrogen pressure change at the sensing electrode was compared with two simple diffusion models. (auth) (UK)

50734 (SC-RR-710546) DATA ACQUISITION SYSTEM WITH ISOLATED OUTPUT VOLTAGE FOR ACQUIRING EVENTS-VERSUS-VOLTAGE SPECTRA. Auer, Robert E. (Sandia Labs., Albuquerque, N. Mex.). Sep 1971. 19p. Dep. NTIS.

A power supply programmer has been developed which allows high-speed programming along with standoff capabilities in excess of 4 kilovolts. By interfacing this programmer with a multichannel analyzer, an automated data acquisition system for taking events-versus-voltage data has been constructed. The use of this system with a hemispherical electrostatic analyzer is discussed. Also discussed are electronic measurements which were made of the total relative accuracies of the system. (auth)

50735 (SGAE-2021) DYNAMIC SENSITIVITY OF QUADRUPOLE MASS SPECTROMETERS. Pichlmayer, F.; Ruedenauer, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). Jun 1972. 19p. (In German). (PH-119/72). Dep. NTIS (U. S. Sales Only).

The partial pressure sensitivity and dynamic range of a commercial quadrupole mass-spectrometer were measured as a function of resolution, pressure and ion source parameters in the mass range 4 to 130 amu. The transmission as a function of the mass number was investigated for two polyisotopic elements. The detection limit of a certain kind of ions depends on the background level which is nearly constant over the whole mass range. The height of the background is proportional to system pressure and varies for different gases. The peak/background ratios of 6 different gases were measured with Faraday collector and electron multiplier. An influence of scattered beam ions by residual gas molecules on this ratio was not found in the investigated pressure range. These results obtained for gaseous ions were compared with measurements on injected thermal ions and sputter ions. (auth)

50736 (SLAC-118) ENGINEERING OF ACCESS CONTROL MECHANISMS IN PHYSICS DATA BASES. Hoffman, Lance J. (Stanford Linear Accelerator Center, Calif.). Jul 1970. Contract AT(04-3)-515. 46p. Dep. NTIS.

A model is presented for engineering the user interface for large data base systems in order to maintain flexible access controls over experimental and other physics data. Several examples of its use are given. The model is independent of both machine and data base structure. Access control is based on sets of procedures called formularies. The decision on whether a user can read, write, update, etc., data is controlled by programs (not merely bits or tables of data) which can be completely independent of the contents or location of raw data in the data base. The decision to grant or deny access can be made in real time at data access time, not only at file creation time as has usually been the case in the past. Indeed, the model presented does not make use of the concept of "files," though a specific interpretation of the model may do so. Access can be controlled at arbitrarily low levels, including the data field level and the bit level. Each element of raw data need appear only once, thus allowing considerable savings in memory and in maintenance effort over previous file-oriented systems. Access controls for physics data banks of the type presented herein are of special interest to regional computing centers or other centers with many independent users. (auth)

50737 CONSTRUCTION OF A FOCUSSING ATOMIC-BEAM MAGNETIC RESONANCE APPARATUS. Ekstroem, C.; Olsmats, M.; Wannberg, B. (Univ. of Uppsala). Nucl. Instrum. Methods; 103: No. 1, 13-26(1972).

A focusing atomic-beam magnetic resonance (ABMR) apparatus has been constructed. The apparatus utilizes a sixpole A-magnet and a fourpole B-magnet, a construction which combines a high transmission with a small collector area. Being intended mainly for work on elements difficult to deflect, i.e., those with high evaporation temperature or small atomic g-value, the ratio of length to radius has been chosen relatively large. An oven construction particularly suitable for high-temperature work is described. The atomic-beam apparatus is equipped with internal detectors for "on-line" detection of short-lived activities. This system has been used in spin-measurements of nuclei with half-lives as short as two minutes. (auth)

50738 PRISM MASS SPECTROMETER WITH WEDGE-SHAPED POLES. Kel'man, V. M.; Uteev, M. L. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 234-7(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 292-6(Feb 1972).

The construction and experimental tests of a prism mass spectrometer with wedge-shaped poles are described. It is shown that the use of such poles leads to an increase in the dispersion of the instrument and to a decrease in the number of ampere-turns required for the field coils. The resolving power of the mass spectrometer, measured at half-maximum of the peaks, is 3400 for source and collector slit widths of 0.1 mm. (auth)

50739 ION-OPTICS SOURCE WITH A DISTRIBUTED IONIZATION REGION. Gall', L. N.; Stepanova, M. S. (Special Design Dept. for Construction of Analytic Instruments, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 335-40(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 421-8(Feb 1972).

A collimating system for ion optics made up of thick electrodes for a gas ion source in a mass spectrometer is described. The system is studied by simulation in an electrolytic tank with automatic trajectory tracing. The yield is determined for ions with various initial energies. A method is developed for determining the width of the ion beam ahead of the exit slit of the ion source by sweeping the ion beam with respect to this slit by means of the field in a deflecting electrostatic condenser located within the collimator. As an example, the width and intensity distributions of $^{14}N^+$, $^{28}N^+$, and $^{202}Hg^+$ beams are described; the energy resolution is also discussed. (auth)

50740 TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK I. (Proceedings of the Union Research Institute of Instrument Construction. Issue I). Matveev, V. V. (ed.). Moscow; Atomizdat (1964). 239p.

This issue marks the launching of a new periodical in the field of nuclear instrumentation in the form of an annual, with the publication of twenty papers by various authors. A half dozen articles cover different aspects of multichannel analyzers. Semiconductor detectors for nuclear radiation, the calibration of radioactive sources and radiometric apparatus, and apparatus for the radiometry of gases and liquids are described. Back-scattering of gamma radiation in scintillation counters, the measurement of neutron radiation doses over a wide energy range, detector count rate improvements, and the radiometry of beta-active gases are among the techniques discussed. One paper is concerned with the temperature dependence of the signal of a scintillation counter during excitation by alpha and gamma radiation. Other topics considered of importance include the use of statistical analysis for radiation measurement and the half-life of ^{117}Te. (K.S.W.)

50741 TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTUTUTA PRIBOROSTROENIYA. VYPUSK V. (Proceedings of the Union Research Institute of Instrument Construction. Issue V). Matveev, V. V. (ed.). Moscow; Atomizdat (1967). 132p.

Issues VI et seq. of this serial are henceforth to be published under the title "Nuclear Instrument Construction." Issue V includes 14 papers on such topics as automatic stabilization of spectrometers, modified uses of semiconductor detectors, multichannel analyzers, and memory devices. Transistorized amplifiers in the measurement of ionizing radiation and the theory of remote dosimetric apparatus receive attention. One paper covers the use of a neutron spectrometer for determining the biological dose. (K.S.W.)

50742 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK VI. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue VI). Matveev, V. V. (ed.). Moscow; Atomizdat (1967). 436p.

This issue incorporates 26 instrumentation papers on equipment for measuring and detecting fission products, neutrons, beta and gamma radiation, and methods for dosimetry and calibration. Scintillation $\beta-\gamma$ spectrometry, neutron spectrometry, γ-resonance devices, the measurement of the flux of electron beams, assay of radioactive aerosols, the control of hermetically sealed fuel elements, and the physico-chemical and nuclear physics properties of fission products are discussed in a number of papers. Elsewhere attention is turned to fast-acting multichannel analyzers, broad-band recorders, circuitry for radiometric work using transistors and diodes as controlling elements, prospects for further miniaturization of equipment, and the unification of modular blocks for detection, recording, and spectrometric investigation of nuclear radiation. (K.S.W.)

50743 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK VIII. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue VIII). Matveev, V. V. (ed.). Moscow; Atomizdat (1968). 152p.

This release of 19 papers from various authors includes treatment of the following subjects: an automated Moessbauer spectrometer, a smoothing memory block, an impulse counter with analog recording of results, digital meter of small currents, a charged-particle detector for low energies, a spectrometer for low-energy electrons, and a miniaturized controlled source of alpha reference signals for stabilizing scintillation spectrometers. The isotope ^{239}Pu was designed into a series of alpha sources and tested. A comparative analysis of a fast-acting address system in memory devices is made. (K.S.W.)

50744 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK IX. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue IX). Matveev, V. V. (ed.). Moscow; Atomizdat (1968). 222p.

This compilation of 23 articles is devoted to a variety of topics in the field of nuclear instrumentation. Determination of the mean free path of gamma quanta in a substance using a Monte Carlo method is described. The measurement of an aerosol concentration, allowing for self-absorption, and the effectiveness of recording alpha radiation in an aerosol are considered. Techniques are detailed for determining the quantum yield of the photoeffect for 200 keV to 1.0 MeV gamma radiation, and for studying beta-gamma coincidence in a magnetic spectrometer with two lenses. Semiconductor and transistorized low-noise amplifiers are presented. A number of papers deal with various aspects of multichannel analyzers. Memory devices with tunnel diodes and other designs for various applications are described in four papers. (K.S.W.)

50745 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRIBOROSTROENIYA. VYPUSK XI. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue XI). Matveev, V. V. (ed.). Moscow; Atomizdat (1969). 197p.

Issue XI of this series of articles on nuclear instrumentation contains 17 articles including techniques for measuring ionizing radiation, rapid determinations of hidden energy, and precipitating particles in selected tubes. The use of low-power transistors in several applications, and semiconductor detectors and amplifiers in spectrometry are discussed. The errors in the analysis of uranium isotopes by a gamma spectrometric method, and the measurement of ^{41}Ar activity are the topics examined in the last two papers. (K.S.W.)

50746 YADERNOE PRIBOROSTROENIE. TRUDY SOYUZNOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA PRI-

BOROSTROENIYA. VYPUSK XVI. (Nuclear Instrument Construction. Proceedings of the Union Research Institute of Instrument Construction. Issue XVI). Matveev, V. V. (ed.). Moscow; Atomizdat (1971). 143p.

Included in this assembly of 17 articles on nuclear instrumentation are two short surveys of the special topics: distortion in pulse height spectra (13 references) and rejection techniques for overlapping pulses in amplitude measuring devices (18 references). Other papers are devoted to such subjects as a pulse discriminator, Moessbauer and gamma-resonance spectrometers, control of a pneumatic transport arrangement, a measuring amplifier, and the analysis of tin and molybdenum. (K.S.W.)

50747 RECENT IMPROVEMENTS TO ION ANALYZERS AND TYPICAL EXAMPLES OF APPLICATIONS. Rouberol, J. M.; Basseville, P. (Societe CAMECA, Courbevoie, France). Rev. Tech. Thomson-CSF; 4: No. 1, 135-58(Mar 1972). (In French).

Recent improvements made to the ion analyzer developed by CAMECA are described. They relate to the primary-ion source (now of the duoplasmatron type), the secondary ion filtering system (a mass resolving power of 1000 has been achieved) and the secondary-ion detector, which can operate in the counting mode and be connected to a spectrum accumulator with programmed scanning. Examples given as applications illustrate the most recent advantages offered by the ion analyzer in the field of microanalyses: the unlimited range of elements that can be analyzed, the possibility of in-depth analyses by progressive scouring and the high recording speed for the chemical-distribution images. (France)

50748 BASELINE RESTORER FOR PULSE HEIGHT SPECTROMETRY. Gal, Janos. ATOMKI (At. Kut. Intez.) Kozlem.; 13: No. 4, 193-200(1971). (In Hungarian).

The resolution of pulse height spectrometers at high counting rates is mostly limited by baseline shift occurring in the main amplifier. This baseline shift can be eliminated by the application of a baseline restorer. A variant of the Robinson—Chase baseline restorer is presented, as well as experiences obtained with the instrument. (8 figures) (auth)

50749 ELECTRIC NOISES IN NUCLEAR MEASUREMENTS. Rubecz, Mihaly. ATOMKI (At. Kut. Intez.) Kozlem.; 13: No. 4, 207-12(1971). (In Hungarian).

The different types of noise signals of external origin, their effects on measurements, and filtering methods are discussed. A survey is given of noises coming from AC power lines, line voltage noise filters, as well as of noises due to improper grounding, those caused by electromagnetic radiation, and the protection against them. The principle of AC stabilizers is summarized, and the data of two types of HF noise filters developed for AC stabilizers are given. (6 figures) (auth)

50750 ENERGY SELECTOR FOR CHARGED PARTICLES. Ballu, Yves; Degras, Denis; Regnaud, Christian (to Commissariat a l'Energie Atomique). French Patent 2,088,650. 13 Dec 1971. Filed 20 Apr 1970. (In French).

An energy selector suitable for a beam of charged particles is described. The device utilizes an electric field for the separation. A first planar electrode is provided with an entrance and an exit aperture for the beam; a second electrode, which is parallel to the first, is provided with a series of orifices positioned in a regular network; a third electrode is provided after the second electrode. The electric field between the two first electrodes results in the particles injected at the input being brought towards the first electrode. The electric field between the second and third electrode is in the opposite direction to the first electric field; the lines of force in the region situated between the first and second electrode are thus distorted. The distance between the two first electrodes and the electric field in the region separating them are such that the selected particles leave the device after having crossed the region where the field has been perturbed by the third electrode. (France)

50751 APPARATUS FOR MEASURING LINEAR DISPLACEMENTS. Michaud, J. F.; Delapierre, Gilles (to Commissariat a l'Energie Atomique). French Patent 2,086,854. 6 Dec 1971. Filed 10 Apr 1970. (In French).

An apparatus for measuring the linear displacement of equipment associated with ion sources is presented. The apparatus enables small-amplitude displacements to be measured with high accuracy (of the order of a micron) in high-vacuum systems, in the presence of a parasitic electromagnetic field, and possibly intense vibrations. The apparatus utilizes a displacement gage consisting of a rule and cursor, able to be displaced in a parallel manner with respect to one another. The rule and cursor are provided with electrically conducting bands having a particular separation; these bands are in electrical contact with one another. The relative displacement of the rule and cursor produces a periodic variation in the capacitance between the opposing faces of the rule—cursor system. (France)

50752 INJECTION-SYRINGE WITH RADIOPROTECTIVE LEAD SHEATH FOR THE MANIPULATION OF ^{99m}Tc AND ^{113m}In. Rohacek, J.; Vlcek, J. Radiobiol.-Radiother.; 13: No. 3, 397-400(1972). (In German).

For the manipulation of generator nuclides ^{99m}Tc and ^{113m}In, the use of a protective lead sheath around the injection syringe for decreasing the radiation dose to the staff is recommended. In the use of ^{99m}Tc a sufficient radioprotection is given so that the duration of work does not have to be limited. For ^{113m}In an attenuation of a factor of 4 is achieved. By using the described protective lead sheath an exceeding of the permissible dose for the hands need not be feared if the protective lead sheath with fully aspired syringe (5 mCi/5 ml) is held in hand for the exclusive manipulation with ^{113m}In for not longer than 2 hours a week. (4 figures, 2 tables) (auth)

50753 HIGH-OUTPUT ROTATIONAL TYPE ^{60}Co TELETHERAPY APPARATUS. Yuasa, Mitsuo; Suzuki, Hirotsugu; Honda, Kenji (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev., Int. Ed.; No. 69, 25-31(May 1972).

Recently, the application of betatrons and linear accelerators to radiation therapy has produced positive results. The increased specific activity of ^{60}Co makes it easy to obtain a high-output small-diameter radiation source. A new high-output, easy-to-operate rotational-type ^{60}Co teletherapy apparatus is described. (12 figures, 1 table) (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

50754 (AEC-tr-7138) RADIATION TECHNOLOGY. NO. 3. Proceedings of the Institute of Radiation Technology. Shtan, A. S. (ed.). Translation of Radiats. Tekh.; No. 3, (1969). 260p. (TT-70-50152; IPST-Cat.-5843). Dep. NTIS.

Forty-five papers from studies of radiation technology in the USSR are presented. A separate abstract was prepared for each of 44. One paper was not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 50210–50213, 50251, 50252, 50320–50322, 50453–50455, 50514–50521, 50703–50711, 50723, 50724, 50755, 50777, 50785, 50786, 51185, 51238, 51239, 51960–51962, 52204, 52240, and 52241.

50755 (AEC-tr-7138, pp 210-17) PROBLEMS OF ECONOMIC FORECASTING IN RADIATION TECHNOLOGY. Purtova, M. I.; Shtan, A. S.; Kodyukov, V. M. Translated from Radiats. Tekh., No. 3, (1969).

A method for calculating the economic feasibility of industrial uses of radioisotope methods, instruments, and facilities is described. The parameters used in calculating economic feasibility are discussed and related to particular industrial uses of radioisotopes such as gamma radiography, thermoelectric generators, gamma-irradiation systems, and radiometric instruments. Experience with particular instruments and equipment which were developed and put into production in the USSR showed that economic feasibility predictions made during the planning, design, and development stages were confirmed by actual service results. (L.C.L.)

Isotope Separation (Industrial)

50756 (CEA-R-4307) STUDY OF THE MAINTENANCE OF AN EQUIPMENT CONSISTING OF NUMEROUS COMPONENTS ASSEMBLED IN ENTIRE SUBSETS. Bansard, Jean-Pierre; Descamps, Jean Louis (Commissariat a l'Energie Atomique, Pierrelatte (France)). Jun 1972. 105p. (In French and English). Dep. NTIS (U. S. Sales Only).

A concrete example of maintenance of numerous components assembled in entire subsets is presented. Such a case occurred when the Pierrelatte Gaseous Diffusion Plant started; this plant is composed of a number of diffusion units assembled in groups, sub-cascades, and cascades. Owing to the almost total ignorance about equipment resistance when starting, questions relating to progressive estimation of life duration arose, as well as problems about crossing transient state regime which were solved by using the computer-programmed Markov process. Different maintenance policies are reported; among them the "trigger-off" policy is more specially the matter of original theoretical research. (auth)

50757 (CEA-R-4336) THEORETICAL STUDY OF A COUNTER–CURRENT CENTRIFUGE. APPROXIMATE SOLUTION FOR THE COUNTER–CURRENT EQUATIONS. Jacques, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1972. 27p. (In French). Dep. NTIS (U. S. Sales Only).

By integrating the linearized Navier–Stokes equations linearized along the whole length of the centrifuge, a differential relation between the mean axial velocity and the centrifugal and viscosity forces on the ends is obtained. Then, these equations are integrated near the ends by a boundary layer approximation method. It is assumed that outside the boundary layer, the axial velocity reaches its mean value. In this way the repartition of all physical quantities in the boundary layer is obtained and a differential equation between the mean axial velocity and the boundary conditions imposed on the ends is derived. This equation, valid both for the mechanical and thermal counter-current is solved numerically. Its solution shows the existence of a second boundary layer close to the wall of the tube. The present theory extends Martin's one in that it takes into account: (1) the action of pressure forces; (2) zero velocity on the wall with no transport; and (3) the interaction between mechanical and thermal effects which tend to decrease the efficiency and the intensity of the counter-current. (auth)

50758 (CNEA-313) CONSTRUCTION OF A ^{234}Th GENERATOR. Suner, A. A.; de Batistoni, A. M. L. G.; Gonzalez, M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 8p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The construction of a ^{234}Th generator is described. It is made of a column packed with anionic-ion exchange resin charged with ^{238}U in the uranyl–sulfate form. The ^{234}Th produced by the decay of ^{238}U is eluted with a 0.05 M sulfuric acid –0.025 M sodium sulphate solution. (auth)

50759 (KFK-1483, pp 804-9) OPTIMIZATION OF A HEAVY WATER ENRICHMENT PLANT WITH A HOT/COLD OPERATING H_2/NH_3-EXCHANGE SYSTEM. Lang, G.; Schindewolf, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Jul 1971. (In German). INIS.

The operating conditions of a hot/cold H_2/NH_3 exchange plant for enrichment of heavy water were optimized with respect to minimum production costs. Besides the known separation factors as well as experimentally determined exchange efficiency and gas load of the stages, cost factors for parts of the plant obtained from industry bids and for energy are considered. Optimization is for one-to-three step enrichment systems, the triple enrichment cascade with stripping, and the three-step enrichment/stripping system with transfer column, which utilizes hydrogen as the deuterium source. Optimization of the three-step enrichment/stripping cascade with regenerating column proceeding from water is also considered. Present heavy water cost can be considerably reduced by careful optimization of all process parameters, even for relatively small plants. (INIS)

50760 (KFK-1562) DETERMINATION OF DISSIPATIVE LOSSES IN THE SEPARATION NOZZLE FLOW WITH PITOT-TUBES. Bley, P.; Ehrfeld, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Mar 1971. 46p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted by P. Bley to Technische Hochschule, Karlsruhe (West Germany).

The dissipative losses in the separation nozzle flow were investigated by measuring the impact pressure profiles and the concentration profiles at the separation nozzle exit. Measurements with H_2/C_7F_{14}-gas mixtures show that under flow conditions normally used in uranium isotope separation 60% of the total losses of the process occur in the nozzle system proper. The dissipative losses in the nozzle are mainly caused by friction, whereas the strong demixing in the flow field contributes less to dissipation. By the strong spatial separation between the light carrier gas and the heavy component of the mixture most of the kinetic energy of the flow is transferred into the heavy fraction. Nevertheless, an isentropic pressure recovery of the light fraction, which contains about 75% of the total flow, would still reduce by 25% the specific energy costs of the separation nozzle process. Because of the low Reynolds number ($Re \approx 100$) of the separation nozzle flow a simple diffuser would yield only a very low recovery. However, an efficient pressure recovery should be possible with a nozzle arrangement, which combines the small streams from many nozzles to a uniform flow. The good efficiency of a multijet nozzle system is demonstrated by a theoretical analysis and by model experiments. (auth)

50761 (LIB/Trans-429) FLOW PATTERN INVESTIGATION OF He/Ar AND He/SF_6 MIXTURES IN A SEPARATION NOZZLE BY MEANS OF MOLECULAR FLOW PRESSURE PROBES. Bier, K.; Brandtstadter, H.; Ehrfeld, U.; Ehrfeld, W. (Kernforschungszentrum, Karlsruhe (West Germany)). Translated by A. Bicevskis (Australian Atomic Energy Commission Research Establishment), from report KFK-1440. 55p. Dep. NTIS (U. S. Sales Only).

An abstract of this article prepared from the original appeared as NSA 26: 22927. (Australia)

50762 IMPROVED METHOD FOR OBTAINING DEUTERIUM. Trichet, Jean; Simonet, Guy; Guellaff, J. P. (to L'Air Liquide, Societe Ananyme pour l'Etude et l'Exploitation des Procedes Georges Claude). French Patent 2,076,756. 20 Sep 1971. Filed 27 Jan 1970. (In French).

A method for obtaining deuterium from hydrogen in which at least part of the hydrogen is produced by the oxidation of a metallic bulk using water vapor is described. This bulk is then regenerated by reduction using at least part of the hydrogen obtained. At least part of the hydrogen consists of recycled hydrogen obtained from the gas current produced in the oxidation, the water having been already removed by cooling and condensation. (France)

50763 OPTIMIZATION OF RECTANGULAR-STEPPED CASCADES FOR SEPARATING MULTICOMPONENT ISOTOPIC MIXTURES. Kolokol'tsov, N. A.; Sulaberidze, G. A.; Laguntsov, N. I. At. Energ. (USSR); 33: No. 2, 704-6(Aug 1972). (In Russian).

Conditions are formulated under which the total flow of a real, rectangular-stepped cascade with a specified number of sections and with maximum efficiency may be computed. Both two-component and multicomponent mixtures of isotopes are treated with the goal of optimizing their separation. (K.S.W.)

50764 LIMITING ENRICHMENT OF INTERMEDIATE ISOTOPES IN THE OUTPUT MATERIAL FROM THE ENDS OF A CASCADE. Minenko, V. P. At. Energ. (USSR); 33: No. 2, 703-4(Aug 1972). (In Russian).

Starting with a typical cascade migration equation that describes concentration distribution, cascade profile, and take-off flow rate, a mathematical development is conducted so as to allow for material balance in the multicomponent mixture of isotopes, a given concentration gradient, and similar factors. A relationship was obtained that permits estimation of the limiting enrichment of isotopic material at the ends of the cascade. (K.S.W.)

50765 METHOD FOR THE ISOTOPIC ENRICHMENT OF HYDROGEN. Courvoisier, Pierre; Lambert, Irma (to Commissariat a l'Energie Atomique). French Patent 2,079,706. 18 Oct 1971. Filed 10 Feb 1970. (In French).

A method for the isotopic enrichment of hydrogen by isotopic exchange between hydrogen and liquid ammonia was developed. A tertiary amine such as triethylamine or tripropylamine is added to the alkaline amide solution in liquid NH_3 (the catalyst). (France)

50766 PROCESS FOR THE ISOTOPIC SEPARATION OF URANIUM. Zinopoulos, N. P. French Patent 2,085,430. 24 Dec 1971. Filed 21 Apr 1970. (In French).

In this isotopic separation process, UF_6 is centrifuged in the liquid state under a pressure of between 20 and 50 bars. The rotation of this apparatus produced a centrifugal force which ensures the opening of the valve and its calibrating springs. The closing of this valve facilitates the collection of the separated products. (France)

Isotopic Power Sources

Refer also to abstracts 50456–50458, 50463, 50465, 50469–50474, 50480, 50522, and 51071.

50767 (AD–736603) RADIOACTIVITY RELEASE FROM RADIONUCLIDE POWER SOURCES. IX. RELEASE FROM $^{170\ 171}Tm_2O_3$ AND $^{147}Pm_2O_3$ TO SEAWATER. Final Report. Kubose, Donald; Goya, Harry (Naval Ordnance Lab., White Oak, Md.). 8 Dec 1971. 18p. (NOLTR–71-206). NTIS.

In the event that a radioisotope-fueled SNAP unit is placed accidentally in an ocean environment the potential release of the radioisotopic fuel material to the ocean environment may generate a radiological hazard. Studies of the nature and extent of such a release are required for assessment of the magnitude of the radiological hazard. The dissolution behavior of two candidate fuels, thulium-170/171 oxide and promethium-147 oxide, in seawater and in seawater-ocean-bottom material mixtures is described. Plots of the amounts of Pm_2O_3 and Tm_2O_3 released to seawater are presented. (NTIS)

50768 (JAERI-Memo–4079) DEVELOPMENTS AND APPLICATIONS OF RADIOISOTOPE POWER GENERATOR IN THE WORLD. (Japan Atomic Energy Research Inst., Tokyo). 30 Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

Development and applications of radioisotope power generators in the world were investigated in which the physical principles, critical items in the design process, advantages in the utilization in various fields, and a precise table of the generators are also included. (Japan)

50769 (MLM–1123) PREPARATION OF THE ^{238}Pu TRANSIT 4A HEAT SOURCE. Birden, J. H.; Blanke, B. C.; Etter, D.; Lonadier, F. D. (Mound Lab., Miamisburg, Ohio). 14 Apr 1962. Contract AT-33-1-Gen-53. 10p. Dep. NTIS.

Declassified 2 Nov 1971.

Mound Laboratory recently fabricated a heat source utilizing the radioactive decay of plutonium-238. The heat was converted to electricity by a thermopile, which was used in the Transit 4A satellite. Although the source weighed only 355 grams, it will supply a total of 1.8 megawatt hours of heat over a four-year period. Over 29 megawatt hours of heat could be obtained during one half-life of the plutonium-238 contained in this small package. (auth)

50770 (MLM–1141) EFFECT OF HIGH TEMPERATURES ON THE INTEGRITY OF RADIOISOTOPE HEAT SOURCE CAPSULES. Rhinehammer, T. B.; Selle, J. E. (Mound Lab., Miamisburg, Ohio). 13 Sep 1962. Contract AT-33-1-Gen-53. 31p. Dep. NTIS.

Declassified 2 Nov 1972.

Two fuel capsules containing plutonium-239 were subjected to the AFSWC burn test. One capsule was undamaged after exposure to 2000°F. The second capsule ruptured and the plutonium alloyed with the tantalum and Haynes alloy-25 outer containers. The capsules were examined by radiography and metallographic techniques. (auth)

50771 (MLM–1168) WELDING DEVELOPMENT FOR CONTAINMENT OF SNAP RADIOACTIVE HEAT SOURCES. Hincks, J. A.; Rhinehammer, T. B. (Mound Lab., Miamisburg, Ohio). [nd]. Contract AT-33-1-Gen-53. 14p. Dep. NTIS.

Declassified 2 Nov 1971.

As part of the SNAP program, techniques were developed for encapsulating plutonium-238 heat sources. A tantalum capsule and cover were designed and welded to contain the isotope; then both were sealed inside a Haynes Alloy-25 outer capsule. The caps for the outer capsule were designed with a central plateau and were triply welded to withstand 500 foot-pounds of impact force. The first weld was a side peripheral weld, the second a top circumferential weld, and the third an overlay weld. The side peripheral weld was developed by Mound Laboratory to meet the stringent impact requirement. Six capsules provided a total 538.22 watts, satisfactorily meeting the wattage requirements. (auth)

50772 (MLM–1257) FABRICATION AND QUALITY CONTROL TESTING OF SNAP-15C CAPSULES. Prosser, D. L.; Kelly, D. P.; Powers, J. A. (Mound Lab., Miamisburg, Ohio). 1 Jul 1965. Contract AT-33-1-Gen-53. 24p. Dep. NTIS.

Declassified 2 Nov 1971.

Heat source capsules for the SNAP-15C program were fabricated and evaluated. These capsules were fueled with sufficient plutonium-238 metal to provide approximately 7.3 thermal watts of power each. Fabrication procedures for these sources, fuel properties, and fabricated capsule parameters are presented. (auth)

50773 (MLM–1258) FABRICATION, TESTING, AND EVALUATION OF SNAP-15A CAPSULES. Prosser, D. L.; Kelly, D. P. (Mound Lab., Miamisburg, Ohio). 1 Feb 1966. Contract AT-33-1-Gen-53. 36p. Dep. NTIS.

Declassified 2 Nov 1971.

The fabrication and evaluation of heat source capsules for the SNAP-15A milliwatt generator are discussed. Each capsule contained sufficient plutonium-238 metal to provide approximately 1.6 watts of heat. Hazards evaluation and fabrication procedures for the sources are presented, together with fuel properties and fabricated capsule parameters. Data for a simulated fire test at 1800°F performed with two fueled units are given. (auth)

50774 (MLM–1261) POODLE HEAT SOURCE DEVELOPMENT AND DEMONSTRATION TEST. Grove, G. R.; Powers, J. A.; Kershner, C. J.; Furtsch, T. A.; Steinmeyer, R. H. (Mound Lab., Miamisburg, Ohio). 15 Jul 1965. Contract AT-33-1-Gen-53. 47p. Dep. NTIS.

Declassified 2 Nov 1971.

The feasibility of the direct-cycle, radioisotope-fueled POODLE thruster was demonstrated. The polonium-210 fuel for this heat source was distributed as gadolinium polonide throughout an annular matrix prepared from pressed tantalum powder. Three of these annular fuel rings were sealed in an inner liner of tantalum, which was chosen as the containment material because of its compatibility with polonium. The inner liner containing the three fuel rings was encapsulated in an outer container of tungsten–25% rhenium alloy, which was sealed by TIG welding and brazing. This capsule alloy was chosen after a very extensive series of tests on different materials, which were evaluated on the basis of high-temperature creep rates, ductility, strength, workability, and stability in a hydrogen atmosphere. Three such capsules containing a total of approximately 600W constituted the heat source for the thruster in the 72-hour power demonstration test, during which the temperature was cycled up to 1500°C while the hydrogen flow was maintained. Examination of one of the three fuel modules after the power test revealed that there were no deleterious effects to the outer capsule which had been exposed to the high-temperature hydrogen, and the tantalum inner liner was compatible with the polonium-210 fuel. (auth)

50775 (MLM–1267) GAMMA RAY DOSE RATES FROM SHIELDED ^{238}Pu SOURCES. Coffey, D. L.; Wylie, K. F. (Mound Lab., Miamisburg, Ohio). 14 Feb 1966. Contract AT-33-1-Gen-53. 10p. Dep. NTIS.

Declassified 22 Oct 1971.

Theoretical gamma ray dose rates from shielded, cylindrical plutonium-238 sources were computed and compared with measured dose rates. The measured and theoretical gamma ray dose rates agreed when suitable instrumentation and procedures were used and when certain theoretical effects were taken into consideration. The agreement between the values indicated that the published mass attenuation coefficients for plutonium and the elements used in the shielding materials are sufficiently accurate for computing dose rates. The agreement also validated self-absorption corrections which assumed a spherically distributed source; the corrections were valid when the length to diameter ratio of a cylindrical source was three or less. This method of computing dose rates could be applied to any gamma emitting source. (auth)

50776 (MLM–1273) ^{210}Po ISOTOPIC POWER SOURCES: A SUMMARY REPORT. Grove, G. Richard; Powers, James A.; Kershner, Carl J.; Furtsch, Thomas A. (Mound Lab., Miamisburg, Ohio). 1 Jun 1965. Contract AT-33-1-Gen-53. 124p. Dep. NTIS.

Declassified 2 Nov 1971.

Research and development progress on ^{210}Po fuels for use in isotopic space power systems is summarized. Information is included on metallic fuel forms and capsule materials. (J.R.D.)

Radiation Sources

Refer also to abstracts 50515–50521, 50580, 50622, 50753, 50754, and 51158.

50777 (AEC-tr–7138, pp 89-93) MEASUREMENT OF THE ACTIVITY OF AN ISOTOPE IN STRONG GAMMA-RADIATION SOURCES. Kodyukov, V. M.; Terent'ev, V. P.; Ostretsov, L. A.; Forafontov, N. V.; Sokolov, A. I.; Fradkin, G. M. Translated from Radiats. Tekh.; No. 3, (1969).

The use of the spectrometric method for measurement of the activity of strong gamma sources is illustrated for two ^{137}Cs sources. The results were 79,000 ± 16,000 and 60,000 ± 12,000 curies, as compared with the values 80,000 ± 5,600 and 66,400 ± 4,600 curies obtained with the calorimetric method. It was concluded that the results of the two methods were in fairly good agreement, and that the spectrometric method will prove useful for the determination of isotope strengths in strong radiation sources. (R.W.R.)

50778 ISOTOPES AND RADIATION TECHNOLOGY. VOLUME 9, NUMBER 4. Baker, P. S.; Lafferty, R. H. Jr.; Gerrard, Martha; (and others) (eds.). One of the Four Quarterly Technical Progress Reviews Published for the Technical Information Center, USAEC. Oak Ridge, Tenn.; Oak Ridge National Laboratory (1972). 157p. GPO $0.70.

Separate abstracts were prepared for 12 of the 44 articles presented. The remaining 32 articles were abstracts and summaries of previously published papers. (W.H.K.)

For abstracts of individual papers see: 50225, 50226, 50311, 50428, 50715, 50716, 50779, 50789–50791, 50993, and 51158.

50779 IN VIVO TISSUE ANALYSIS WITH ^{109}Cd. Preuss, Luther E.; Bolin, Frank P. (Edsel B. Ford Inst. for Medical Research, Detroit). Isotop. Radiat. Technol.; 9: No. 4, 501-4(1972).

A system was developed for in vivo quantitative analysis of soft tissue. Preliminary work has indicated that ^{109}Cd is ideal for such an analysis, and use of a ^{109}Cd source has permitted determination of the percentage of fat in a given sample to within 2%. The attainment of this precision depends strongly on the initial assumptions regarding body composition. A composition of 77.4% O, 9.03% C, 10.0% H, 2.69% N, 0.31% K, 0.24% S, 0.19% P, 0.08% Na, and 0.08% Cl is considered to be representative of fat-free tissue, whereas 77% C, 11.5% O, and 11.5% H is the composition of choice for fat. Absorption experiments on assorted fats and lean meats support these assumptions. In addition, in vivo results have been obtained on humans and correlated with skinfold-thickness measurements. (auth)

50780 PRODUCTION OF ^{43}K FOR MEDICAL USE. Clark, J. C.; Thakur, M. L.; Watson, I. A. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 329-35(Jul 1972).

A dynamic argon gas target system is described for the production of ^{43}K and the method for recovery of the activity is stated. The influence of the incident alpha particle beam energy on the relative yield of ^{42}K and ^{43}K is reported. The effects of other parameters were investigated, such as gas pressure and gas flow rate on the yields. The results are discussed. (auth)

50781 RADIOACTIVE ISOTOPES DO NOT IMPROVE LIGHTNING PROTECTION. Baatz, H. (Verband Deutscher Elektrotechniker, Frankfurt am Main). Elektrotech. Z., A; 93: No. 2, 101-4(1972). (In German).

An investigation was made into the effect of radiation (^{241}Am, ^{226}Ra) on lightning conductors using breakdown gaps with direct and impulse voltages. As was expected from the ratio of the energy of the radiation to the energy of the predischarges, this had no effect on predischarges and breakdown behavior. In the case of large-area buildings the Faraday cage offers the best lightning protection. (GF)

50782 MEASUREMENT OF SCALE INSIDE PIPES BY USING ^{192}Ir GAMMA-RAY SOURCE. Tsujimoto, Tadashi (Kyoto Univ., Osaka); Katsurayama, Kosuke; Yamaguchi, Takashi. Hihakai Kensa; 21: No. 6, 331-5(Jun 1972). (In Japanese).

The scale accumulated as deposits inside the iron pipes used in chemical plants of the petroleum industry or in the steam power plants has been routinely inspected by the several kinds of nondestructive methods such as ultrasonic testing and gamma radiography. ^{192}Ir is usable as the gamma source for radiography. The measurements of scale thickness inside pipes used in the petroleum industry were carried out and very useful results were obtained. The thickness of scale accumulated artificially inside pipes was measured by this method and it was found that the detectable minimum scale thickness was 0.5 mm. Since the minimum significant level of scale thickness in the petroleum industry is at most 5 mm, the method suggested here is usable. (auth) (Japan)

Design and Fabrication

Refer also to abstracts 50660, 50740, and 50743.

50783 (AD–735340) 2-CURIE ^{60}Co GAMMA POINT SOURCE STORAGE AND EXPOSURE DEVICE. Allen, K. James (Harry Diamond Labs., Washington, D. C.). Nov 1971. 16p. (HDL-TM–71-20). NTIS.

A calibration device has been developed by the Harry Diamond Laboratories for handling two small radioactive gamma-ray point sources. This device is used as a basic radiation reference in calibrating a thermoluminescent dosimeter system. The sources, 2 curies of ^{60}Co and 1 curie of ^{137}Cs, are stored in a lead keg mounted on castors and are string operated. Exposure at surface of lead container is 2 to 4 milliroentgens per h. The device includes such design features as remote source handling, fail-safe operation, adequate storage shielding, simplicity of construction and operation, and minimum scattering and field distortion during use. It is available for use at the HIFX facility. (auth) (NTIS)

50784 (MLM–1905) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY–MARCH 1972. (Mound Lab., Miamisburg, Ohio). 30 Jun 1972. Contract AT-33-1-GEN-53. 28p. Dep. NTIS.

Research and development progress is reported on plutonium dioxide–molybdenum cermet (PMC) fuels, pacemaker fuel, pressed plutonium dioxide (PPO) fuel spheres for the multihundred watt program, coating PMC spheres with Mo and W, impact stability of PPO spheres, powder blending for fabrication of PMC disks, parameters of PMC fueled heat sources, dissolution of plutonium dioxide, and analytical standards for contamination limits in Ta–10 wt % W alloys. (J.R.D.)

Industrial Uses

Refer also to abstracts 50711, 50723, and 50724.

50785 (AEC-tr–7138, pp 228-30) PRELIMINARY EVALUATION OF THE ECONOMIC INDICES OF HIGH-INTENSITY GAMMA-FACILITIES. Gladkikh, V. N.; Osipov, V. B.; Purtova, M. I.; Akopov, V. S. Translated from Radiats. Tekh.; No. 3, (1969).

A method for the preliminary evaluation of the main economic parameters of high-intensity gamma-irradiation facilities is presented. These economic parameters include: capital investment in the facility; production of facility; cost of production; recoupment period of capital investments; and profit associated with the use of the facility. (L.C.L.)

50786 (AEC-tr–7138, pp 237-46) METHOD FOR THE INVESTIGATION OF THE EFFECT OF RADIOISOTOPIC STATIC-ELECTRICITY NEUTRALIZERS ON THE TECHNICAL-ECONOMIC PARAMETERS OF PRODUCTION PROCESSES. Purtova, M. I. Translated from Radiats. Tekh.; No. 3, (1969).

Static electricity is generated in a great variety of industrial processes and causes reduced production speed, rejected products, idle equipment, and fire and explosion hazards. The most effective method for eliminating static electricity involves ionization of air by nuclear radiation using a radioisotope source. The economic feasibility of using radioactive static eliminators in industrial processes was evaluated by special studies carried out under manufacturing conditions in order to analyze the technical-economic indices of the manufacturing process affected by the radioisotope neutralizers. The method of study, selection of parameters, processing of data, and results obtained are described. The results indicate that the use of radioactive static eliminators can increase production output, decrease labor requirements, and, finally, reduce the cost of a production operation by from 0.1 to 3.0%. (L.C.L.)

50787 (CONF-680569) OPERATION IRAD: ON THE PROMOTION OF APPLICATIONS OF IRRADIATION TECHNIQUES, LYON, MAY 3–12, 1968. Rispal, Ch. (ed.) (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). 201p. (In French).

The Eurisotop Bureau organized a demonstration campaign, named operation IRAD, to promote irradiation techniques. The program consisted of irradiation demonstrations, expositions presenting application possibilities, and information meetings and discussions. The papers presented during the visit at Lyon are compiled. These include present applications of radiation in biology, radiosterilization, mutagenic action of γ rays on Lactobacillus, sterilization of medical products, preservation of agricultural and food products, preservation of fruits and legumes, food irradiation installations, legislative aspects of irradiation, textile applications of irradiation, irradiation installations, application of radiations to macromolecular chemistry, industrial reticulation of polyethylene, radioinduced wood–plastic combinations, and drying of varnish and paints by electron irradiation. (J.S.R.)

50788 (ORO–4156-1) EVALUATION OF TREATMENT PLANTS BY TRACER METHODS. Annual Report, January 15, 1971–January 14, 1972. Craft, T. F.; Eichholz, G. G.; Millspaugh, S. N. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Feb 1972. Contract AT(40-1)-4156. 45p. Dep. NTIS.

To overcome the practical difficulties associated with the use of radiotracers or dye markers in evaluating the performance of sewage treatment plants, the use of stable elemental tracers followed by post-sampling neutron activation analysis has been investigated. Of the various possible tracer elements, indium offers the greatest attraction on account of its high neutron capture cross section, its absence from most natural waters, and its low toxicity. Tests have been performed to establish the most convenient procedure for using tracers in soluble form or adsorbed on various particulates in investigations of treatment plant performance. Field tests have been conducted at several treatment plants in the Atlanta, Georgia region. The performance of sedimentation basins, trickling filters, and activated sludge tanks has been studied and abnormal operating conditions have been demonstrated in some cases. Work is proceeding to explore the potentialities of the method further, to improve the cost of the test work, and to ensure dissemination of test results within the industry. (auth)

50789 NUCLEAR TECHNIQUES FOR PRODUCT INSPECTION AND QUALITY ASSURANCE. Hill, Robert F. (General Motors Corp., Warren, Mich.). Isotop. Radiat. Technol.; 9: No. 4, 385-92(1972).

The increasing emphasis on automotive safety and reliability through product assurance has stimulated the development of new and improved inspection methods. Nuclear techniques are finding ever-increasing application and have been used successfully in a variety of automotive-inspection problems. Some of the unique methods that have been developed are presented to demonstrate the versatility of nuclear techniques when unusual inspection problems arise e.g., measurement of oil consumption of production engines, monitoring of composition of continuously cast bearing material, detection of internal voids in plastic-foam parts, and measurement of the moisture content of foundry sand. (auth)

50790 EVALUATION OF ^{252}Cf AS A NEUTRON RADIOGRAPHY SOURCE. Barton, J. P.; Klozar, M. F. (Argonne National Lab., Ill.). Isotop. Radiat. Technol.; 9: No. 4, 396-405(1972).

Experiments were performed to test the suitability of the spontaneous-fission neutron source ^{252}Cf for neutron radiography. With a water moderator, the measured ratio of fast-neutron yield-to-peak thermal-neutron flux is at least a factor of 2 better than obtained with other sources. Divergent cadmium-lined collimators were studied over a range of ratios from 1:7.5 to 1:30. The effects of collimator ratio on (1) exposure rate, (2) contrast of selected materials, and (3) resolution were evaluated. As the collimator ratio is increased, the exposure rate decreases at a rate less than that predicted by the inverse-square law, and, although contrast decreases, the overall detail in the neutron radiograph increases rapidly. The effects of changes in beam-extraction geometry and in the collimator dimensions for a constant collimator ratio are shown. In particular, the introduction of a 5-cm air gap between source and collimator in tangential geometry is more advantageous to radiographic resolution than a factor of two in collimator ratio. Detection methods demonstrated include LiF–ZnS scintillator and gadolinium-metal conversion screens with neutron exposures of 7×10^5 n/cm^2 and 1.3×10^8 n/cm^2, respectively. (auth)

50791 MEASUREMENT OF GAS DISTRIBUTION WITH ^{41}Ar. Williams, C. L.; Rust, J. H.; Colwell, G. T. (Georgia Inst. of Tech., Atlanta). Isotop. Radiat. Technol.; 9: No. 4, 419-21(1972).

The use of ^{41}Ar to measure the distribution of a gas in a container is described. The equipment, procedure, and results are discussed. (auth)

50792 RECENT PROGRESS IN THE AREA OF THE IRRADIATION OF FOODS. Constant, R.; Schietecatte, W. (CEN, Mol, Belgium). Bull. Ass. Anciens Eleves Inst. Ind. Ferment. Bruxelles; 13: No. 89, 1-5(Jan-Feb 1970). (In French).

The value of irradiation in food preservation is briefly outlined. The criteria used as the basis for the selection of a subject of study and industrialization were examined. The present possibilities and irradiation installations are described, and the national programs are indicated. (J.S.R.)

50793 METHOD AND EQUIPMENT FOR LOCALIZING LEAKS IN UNDERGROUND PIPES. Dorgebray, Gerard (to ELF-Union). French Patent 2,088,609. 13 Dec 1971. Filed 17 Apr 1970. (In French).

A procedure for detecting and localizing leaks in underground piping transporting fluids (liquid or gaseous hydrocarbons) is described. The procedure consists of circulating a fluid containing a radioactive tracer material, washing the piping so that all traces of radioactive material are eliminated from the interior, and detecting the regions of high residual radioactivity around the piping with a detection device moved along inside the piping. An energetic γ emitter (^{82}Br) having a half-life at least equal to the time taken by the fluid to traverse the piping is used as the tracer. The position of the detection device is recorded at every position, where the measured activity exceeds a certain predetermined level. (France)

LIFE SCIENCES

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 50323, 50325, 50328, 50674, 50832, 50901–50903, and 52207.

50794 (AEC-tr-7316, pp 34-45) INVESTIGATION OF CERTAIN PROPERTIES OF LYSOZYME AND RIBONUCLEASE A IRRADIATED IN DRY FORM AFTER THEIR TREATMENT WITH β-MERCAPTOETHYLAMINE. Osipov, V. I.; Maksimov, V. I.; Kaverzneva, E. D. (Inst. of Organic Chemistry, Moscow). Translated from Radiobiologiya; 12: No. 1, 26-32(1972).

The properties of lysozyme and ribonuclease A, subjected to γ irradiation in dry form (dose 30 Mrad, in an atmosphere of nitrogen) and then to a reaction of disulfide exchange in the presence of β-mercaptoethylamine for purposes of renaturation, were investigated. Treatment with this radioprotective agent leads to supplementary disruptions of the structure of irradiated lysozyme: cleavage of disulfide bonds, a decrease in the tryptophan content, and a change in the centers of aggregation. In both irradiated proteins the presence of peroxide compounds which, in all probability, are the cause of their instability and further changes, was demonstrated. (tr-auth)

50795 (AEC-tr-7316, pp 84-90) DETERMINATION OF THE ROLE OF SULFHYDRYL GROUPS AND THE DEGREE OF AGGREGATION OF THE ENZYME IN THE RADIATION DISRUPTION OF THE ALLOSTERIC FUNCTION OF PHOSPHOFRUCTOKINASE. Ermekova, V. M.; Kuzin, A. M.; Mironov, G. P. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 12: No. 1, 58-62(1972).

It was shown by the method of disc electrophoresis in polyacrylamide gel that doses up to 8 kR do not cause any significant changes in the electrophoretic profile of phosphofructokinase. At γ radiation doses of 16 to 50 kR, a dissociation of the large aggregates of the enzyme is observed. It was shown that at irradiation doses of 0.5 to 5 kR the number of surface SH-groups of the enzyme is reduced. In the case of irradiation at a dose of 10 kR the number of surface SH-groups begins to increase, which may be associated with a change in the conformation of the protein molecule, as a result of which part of the covered SH-groups are determined as surface groups. (tr-auth)

50796 (AEC-tr-7316, pp 160-6) COMPARATIVE STUDY OF THE ELASTIC PROPERTIES OF MONOMOLECULAR LAYERS OF SERUM PROTEINS AND THE MORPHOLOGICAL INDICES OF THE BLOOD OF DOGS WITH ACUTE RADIATION SICKNESS. Tkach, V. K.; Dyakov, V. A.; Sukhorukov, B. Z. (Medical Inst., Vinnitsa, USSR). Translated from Radiobiologiya; 12: No. 1, 110-14(1972).

The elastic properties of monomolecular layers of serum proteins and the morphological indices of the blood of dogs were studied after total irradiation at doses of 100, 350, and 700 R. It was shown that the elastic properties of the proteins in experiments in vivo are sensitive to the influence of these doses of x rays. Changes occur after the first day has elapsed, and they undergo phase changes on the following days. (tr-auth)

50797 (AEC-tr-7316, pp 172-8) COMPARATIVE STUDY OF TRYPTIC PEPTIDES OF GLOBINS OF INTACT AND IRRADIATED RABBITS. Sukhomlinov, B. F.; Kuznetsov, G. P. (Lvov State Univ.). Translated from Radiobiologiya; 12: No. 1, 118-22(1972).

The influence of total x irradiation of rabbits at a dose of 850 R on the peptide composition of tryptic hydrolyzates of the protein portion of the hemoglobin molecule was studied. It was shown that penetrating radiation causes changes in the electrophoretic mobility of individual lysine- and arginine-containing peptides. After detection for histidine, arginine, tryosine, and tryptophan, the tryptic fragments found were identified on peptide maps, and the absence of the histidyl residue in the C peptide was also detected on the 5th, 10th, and 20th days after irradiation. The data cited are evidence that x irradiation in vivo leads to a disturbance of the primary structure of the protein component of rabbit hemoglobin. (tr-auth)

50798 (AEC-tr-7316, pp 179-83) STUDY OF THE STRUCTURAL CHANGES IN THE 7S-GLOBULINS OF COTTON SEEDS IRRADIATED BEFORE PLANTING. Ibragimov, A. P.; Tuichiev, A. V.; Yangibaev, M. (Inst. of Biochemistry, Tashkent). Translated from Radiobiologiya; 12: No. 1, 123-5(1972).

The influence of temperature and pH of the medium on the fluorescence intensity and position of the maxima of the spectra of 7S-globulins of cotton seeds, nonirradiated and irradiated before planting, was studied. The fluorescence intensity of the irradiated globulin was 20% greater than in the control. It was established that the rate of temperature quenching of fluorescence in irradiated 7S-globulins is higher than in nonirradiated ones. With increasing pH of the medium (6.0 to 14.0), the fluorescence intensity of the 7S-globulins decreases, and in the irradiated protein the drop in the fluorescence intensity is more rapid than in the nonirradiated protein. (tr-auth)

50799 (COO–1754-8) EFFECTS OF WHOLE-BODY AND X- AND γ-IRRADIATION ON THE BIOSYNTHESIS OF CERTAIN SERUM PROTEINS. Progress Report, September 1, 1971–August 31, 1972. Neuhaus, Otto W. (South Dakota Univ., Vermillion. School of Medicine). [nd]. Contract AT(11-1)-1754. 11p. Dep. NTIS.

In studies of the effect of whole-body irradiation on the hepatic uptake of amino acids, it was found that the hepatic uptake was increased following exposure as a result of the stimulation of a normal sodium ion-dependent transport function. Attempts to correlate the increase in the transport function with changes observed in the plasma membrane of hepatocytes yielded negative results. The following conclusions were drawn from studies on the effects of whole-body irradiation on the hepatic synthesis of plasma proteins in general, and specifically the sex-dependent urinary protein ($\alpha_{2u'}$) in adult male rats. The injury-stimulated synthesis of plasma proteins is not inhibited by whole-body irradiation. The hepatic synthesis of $\alpha_{2u'}$ cannot be induced in pseudohermaphroditic rats by androgen therapy. Hepatic synthesis of $\alpha_{2u'}$ in normal rats is age related. (E.R.B.)

50800 (COO–3411-1) BASIC ASPECTS OF ACTION OF RADIATION ON MICROORGANISMS. Progress Report for the Period September 1, 1971–August 31, 1972. Pollard, Ernest C. (Pennsylvania State Univ., University Park. Dept. of Biophysics). Jul 1972. Contract AT(11-1)-3411. 5p. Dep. NTIS.

Results are summarized from studies on the basic mechanisms involved in radiation injuries in microorganisms. Emphasis is placed on radioinduced degradation of DNA and mechanisms involved in repair, and factors affecting the radiosensitivity of RNA in microorganisms. (C.H.)

50801 (EUR–4810(Vol.1), pp 179-86) RADIATION DAMAGE BY LOW ENERGY HEAVY PARTICLES. Watt, D. E.; Sutcliffe, J. F. (The University, Dundee, Scotland).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Various parameters involving number and type of events, concentration of events, stopping power, and microscopic absorbed doses are calculated for low energy heavy particles in ribonuclease with the object of finding the most appropriate description of radiation quality. It is discussed how measurement of the inactivation cross-sections of ribonuclease for beams of H, He, and C particles at the same velocity may provide a means of discriminating between the various arbitrary definitions of quality. (auth)

50802 (EUR–4810(Vol.1), pp 187-98) CALCULATED STOPPING POWERS, PATH LENGTHS, AND PROJECTED RANGES OF LOW ENERGY HEAVY PARTICLES IN SOFT TISSUE AND RNA. Watt, D. E.; Sutcliffe, J. F. (The University, Dundee, Scotland).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A simple expression which fits, to better than 2%, the nuclear component of stopping power in a free atomic system given by Lindhard et al. is used in the computation of stopping powers of soft tissue and RNA for low energy heavy particles. From this data are calculated path lengths and projected ranges of H, D, He, Li, C, N and O at energies less than 100 keV. It is assumed that the ranges are terminated where the energy of the incident particle falls below that required for direct ejection of a bound oxygen atoms from the medium. (auth)

50803 (EUR–4810(Vol.1), pp 253-65) DISCUSSION OF THE ROLE OF FREE RADICALS IN THE BIOLOGICAL EFFECT OF DIFFERENT LET RADIATION. Chadwick, K. H. (Association EURATOM-ITAL, Wageningen, Netherlands).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The decreasing yield of free radicals with increasing LET and the role of the free radicals in the biological effect are considered in relation to the Burch analysis of radiobiological data. It is suggested that the simple target effect of Burch can be accounted for by free radical production. (auth)

50804 (EUR-4810(Vol.1),pp 289-303) DIRECT AND INDIRECT RADIATION EFFECT IN YEAST CELLS. Frankenberg, D. (Gesellschaft fuer Strahlen- und Umweltforschung, Frankfurt am Main).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Ionizing radiation causes breaks of the nucleotide chain in DNA. Single strand breaks are produced by direct as well as indirect effects and can be repaired by the yeast cells. Double strand breaks are caused only by direct effects. Double strand cuts cannot be repaired and inactivate the cells. Using the track-entity model, the effectiveness of a 22 keV radiation in producing double strand breaks was calculated and compared with experimental data. The DNA is not only affected by direct effects, but also by radicals, which are generated in the surroundings (indirect effect). Since the mean energy transferred to DNA by radicals cannot be calculated, protection by cysteine and repair are used in combination in attempt to determine the number of double strand breaks in the yeast DNA at a given x-ray dose. (auth)

50805 (ORO-3596-17) ALTERATION INDUCED BY X-RAY AND ULTRAVIOLET LIGHT ON THE SYNTHESIS AND MAINTENANCE OF MACROMOLECULAR COMPONENTS WITHIN CELLS. Progress Report, July 1, 1971—June 30, 1972. Billen, Daniel (Florida Univ., Gainesville. Radiation Biology Lab.). [nd]. Contract AT(40-1)-3596. 64p. Dep. NTIS.

Studies designed to assess the effects of uv or ionizing irradiations on control and regulation of DNA replication and repair, and to attempt to relate these effects to cell lethality are reported. Following x or uv irradiation there were found to be quantitative changes in DNA replication. New DNA synthesizing sites were observed; some modification in the methylation of the polymeric DNA synthesized after irradiation and damping of DNA replication cycles was observed. Chromosomal locations of x-ray induced initiation sites in Bacillus subtilis were studied using transformation techniques. Repair synthesis in situ was investigated. Transformation techniques were used to determine whether repair of the chromosome is random or sequential in B. subtilis. The role that the several cellular DNA polymerases play in repair resynthesis was also studied. (C.H.)

50806 PULSE RADIOLYSIS STUDY OF SUPEROXIDE DISMUTASE. Rotilio, Guiseppe; Bray, Robert C.; Fielden, E. Martin (Inst. of Cancer Research, Sutton, Eng.). Biochim. Biophys. Acta; 268: No. 2, 605-9(May 1972).

The superoxide dismutase activity of bovine erythrocuprein was studied by pulse radiolysis under steady-state and pre-steady-state conditions. Enzyme activity is independent of pH in the range 5.3 to 9.5. Cyanide inhibits the enzyme, indicating involvement of copper in the catalytic process. Enzyme turnover is governed by a second-order rate constant for reaction between enzyme and superoxide of $1.8 \times 10^9\ M^{-1} \cdot s^{-1}$. If a Michaelis complex is formed, K_m must be greater than 0.5 mM. Increasing viscosity of the medium by addition of glycerol slowed the reaction, confirming that enzyme turnover is effectively diffusion-limited. (auth)

50807 UV-SPECIFIC ENDONUCLEOLYTIC ACTIVITY PRESENT IN HUMAN CELL EXTRACTS. Bacchetti, S.; van der Plas, A. ; Veldhuisen, G. (State Univ., Leiden. Medical Biological Lab. TNO, Rijswijk, Netherlands). Biochem. Biophys. Res. Commun.; 48: No. 3, 662-9(7 Aug 1972).

An endonucleolytic activity specific for uv-irradiated DNA was detected in extracts of human cells, both normal and defective in the repair of uv-damage. The activity is apparently recognizing a uv-induced damage other than pyrimidine dimers. (auth)

50808 ANOMALOUS BEHAVIOR DURING γ-IRRADIATION OF CHYMOTRYPSIN AND TRYPSIN UNDER NITROUS OXIDE. Lynn, K. R. (National Research Council of Canada, Ottawa). Radiat. Res.; 51: No. 2, 254-63(Aug 1972).

Chymotrypsin and trypsin, when irradiated as dilute aqueous solutions under nitrous oxide both displayed anomalously low values of D_{37}. Destruction of tryptophan residues during the irradiations were, as in previous work, correlated with losses of enzymic activities by both the proteases. Interactions between the gas and the enzymes apparently affected the conformations of the proteins and, consequently, facilitated attack by radicals on the susceptible centers. Concentrated solutions of chymotrypsin irradiated under nitrous oxide did not behave anomalously when compared with previously reported data. (auth)

50809 RANDOM BREAK ANALYSIS OF DNA SEDIMENTATION PROFILES. Gillespie, C. J.; Gislason, G. S.; Dugle, D. L.; Chapman, J. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Radiat. Res.; 51: No. 2, 272-9(Aug 1972).

Monte-Carlo computer simulation of random strand breakage was applied to analysis of alkaline sucrose gradient sedimentation profiles from irradiated DNA. The method is simple and widely applicable, is valid at all radiation doses and for all size distributions of the unirradiated DNA. The data is efficiently utilized, resulting in improved accuracy in determining the efficiency of strand breakage. The analysis provides two tests of conformity of experimental data to the expected breakage and sedimentation behavior. (auth)

50810 EFFECTS OF γ-RADIATION ON A SILICATRYPSIN COMPOUND SUSPENDED IN AQUEOUS BUFFER. Lynn, K. R. (National Research Council of Canada, Ottawa). Radiat. Res.; 51: No. 2, 265-71(Aug 1972).

Trypsin was irradiated as an envelope surrounding colloidal silica that was suspended in aqueous borate buffer. The results obtained from studies of the residual enzymatic activity, and of constituent amino acids destroyed, were compared with those from the enzyme irradiated as a dilute solution in the same buffer. The enzymatic activity to a series of esters and amides was protected at least fifty-fold by the complexing with silica. The relative reactivities, to the synthetic substrates examined, were different for the suspended trypsin from those found with the enzyme freely dissolved. Changes in the three-dimensional structure of the protease on formation of the enveloping monolayer about the colloidal silica, compared with that pertaining in solutions of the enzyme, are the probable causes of the different responses to γ irradiation observed. Aromatic amino-acid residues were those first affected on irradiation of both the free and complexed trypsin. (auth)

50811 PHOTOACTIVATION OF UROCANASE IN PSEUDOMONAS PUTIDA: POSSIBLE CONFORMATIONAL CHANGE DURING ACTIVATION. Hug, D. H.; Roth, D. (Veterans Administration Hospital, Iowa City, Iowa). Photochem. Photobiol.; 16: No. 3, 203-7(Sep 1972).

Earlier studies of urocanase indicated that it is converted to an inactive form in resting cells of Pseudomonas putida. When cell extracts are irradiated by ultraviolet (u.v.) light, the enzyme is activated. The chromophore is closely associated with the enzyme. The action spectrum for photoactivation showed that, although near uv light was effective, the most efficient wavelengths were at 275 to 280 nm. It is suggested that urocanase undergoes a conformational change upon photoactivation. (auth)

50812 PHOTOCHEMICAL REACTIONS OF AROMATIC KETONES WITH NUCLEIC ACIDS AND THEIR COMPONENTS. III. CHAIN BREAKAGE AND THYMINE DIMERIZATION IN BENZOPHENONE PHOTOSENSITIZED DNA. Charlier, M. (CNRS. Orleans, France); Helene, C.; Carrier, W. L. Photochem. Photobiol.; 15: No. 6, 527-36(Jun 1972).

Excitation of benzophenone in the presence of calf thymus and Escherichia coli DNA led to photosensitized damages to the macromolecule. Two main reactions were observed: thymine dimerization and chain break formation. Benzophenone photosensitized chain breaks were also observed in polyadenylic acid. Irradiation was carried out with a filtered osram HBo 200 W lamp, (cutoff about 295 nm). The melting temperature of DNA decreased with the duration of irradiation. The ratio of the yields of dimers and single-chain breaks produced in DNA was about 1. Photosensitized damage to deoxyribose residues leading to chain breakage was shown to be similar to that produced by x or γ irradiation. The oxygen effect upon chain break production was studied and discussed in relation with its effect upon intermediate species. Thymine dimers were formed following energy transfer from benzophenone in its triplet state. Ketyl radicals were not involved in reactions with DNA. It is proposed that OH radicals produced were responsible for the production of single-chain breaks by attack on the deoxyribose residues. (UK)

50813 INTERMOLECULAR INTERACTION IN DNA SOLUTIONS UNDER THE ACTION OF UV-IRRADIATION. Kruglyakova, K. E.; Zhiltsova, V. M. (Inst. of Chemical Physics, Moscow). Stud. Biophys.; 24-25: 429-35(1970).

Ultraviolet irradiation is known to cause profound disturbance of vital processes in the cell. Since DNA may be the main target for uv irradiation, investigation of model systems is of interest in studying the probable mechanism of damage. A specific effect of uv irradiation on DNA was observed under conditions permitting investigation at the molecular level in the in vitro experiments namely denaturation of macromolecules and formation of thymine cross-linkings. (auth)

Radiation Effects on Cells (External Source)

Refer also to abstract 50901.

50814 (AEC-tr-7316, pp 75-83) RADIOSENSITIVITY AND CONTENT OF ENDOGENOUS SH-GROUPS AND REDUCED GLUTATHIONE IN AN ASCITES TUMOR OF THE RAT OVARY AND ITS CLONED SUBLINES. Ismailov, B. I.; Zhemaletdinov, F. G. (Scientific Research Inst. of Oncology and Radiology, Alma-Ata, USSR). Translated from Radiobiologiya; 12: No. 1, 52-7(1972).

In ten different cloned sublines of an ascites tumor of the rat ovary, in the content of endogenous SH groups (protein and nonprotein) and reduced glutathione was compared according to the degree of their natural radioresistance, evaluated according to the criterion of transplantability (TD_{50}) and the lifetime of the animals after transplantation of the tumor. The most pronounced correlation was detected between the radioresistance of the tumors and the level of nonprotein thiols and reduced glutathione. After a single x irradiation at a dose of 1400 R in vivo, a more pronounced postradiation decrease in the sulfhydryl compounds was noted in radioresistant clones than in their radiosensitive variants. (tr-auth)

50815 (AEC-tr-7316, pp 134-42) COMPARATIVE INVESTIGATION OF THE REPRODUCTION OF CERTAIN DNA AND RNA VIRUSES IN CELL CULTURES IRRADIATED WITH GAMMA RAYS. Andonov, P.; Ivanov, B.; Dundarov, St.; Tudorov, Sv.; Mikhailov, A. (Inst. of Epidemiology and Microbiology, Sofia). Translated from Radiobiologiya; 12: No. 1, 92-7(1972).

A comparative investigation was made of the reproduction of two DNA and two RNA viruses in cells irradiated with γ rays. All the investigated viruses (herpes virus, vaccinia virus, Newcastle disease virus, and Coxsackie B_6 virus) reproduce in cells irradiated at doses of 10, 20, and 50 kR. Stimulation of the reproduction of Coxsackie B_6 virus under these conditions was established. The factor promoting the reproduction of Coxsackie B_6 virus was found in the cell culture medium of the irradiated cells as well. Cysteine (0.1–1.0 mmole/ml) eliminates the stimulating effect. The data presented show that human herpes virus and vaccinia virus are more dependent on the structural and functional integrity of the cell than Coxsackie B_6 virus. (tr-auth)

50816 (EUR-4810(Vol.1), pp 267-87) CELLULAR INACTIVATION BY HEAVY IONS, NEUTRONS, AND PIONS. Katz, Robert; Sharma, S. C.; Homayoonfar, M. (Univ. of Nebraska, Lincoln).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The delta-ray theory of the inactivation of cells by energetic heavy ions describes cellular survival after heavy ion bombardment through a two-component survival model, in which four operational parameters (E_0, m, σ_0, and κ) describe the response of a particular cellular variety in a particular ambient condition, for an arbitrary radiation environment. The quantities m and E_0 are the extrapolation number and extrapolated D-37 dose of the survival curve after gamma-ray irradiation. The quantities σ_0 and κ are found from the initial slope of survival curves after irradiation with ions of different LET, and are the value of the saturation cross-section and the value of $z^2/4\beta^2$ at which saturation is achieved, or rather, where the grain-count regime terminates. In this regime, the inactivated cells are like beads on the string represented by the ion's path. Cells may be inactivated by the passage of a single ion, with probability $P = (1 - \exp[-z^2/\kappa\beta^2])^m = \sigma/\sigma_0$, where σ is the cross-section for this inactivation mode, called ion-kill, so that the survival probability after irradiation with a beam of particles with fluence F from this mode is $e^{-\sigma F}$. A second inactivation mode results from the capacity of cells to be "bruised" by the delta-rays from a single ion in the beam, to be killed by the delta-rays from subsequent ions, much as cells are inactivated by secondary electrons from gamma-rays. In this gamma-kill mode, with gamma-kill dose (1-P)D, where D is the dose deposited by the heavy ion beam, the survival probability is $1-[1-e^{-(1-P)D/E_0}]^m$. The survival probability after irradiation with a beam of ions is the product of these two independent survival probabilities. These expressions are extended to a mixed radiation environment in which the spectrum of secondary charged particles is known, to yield survival, OER, RBE, the Anoxic-Aerobic Ratio, and the equivalent monoenergetic beam for neutron and stopped negative pion and heavy ion beam irradiation, where appropriate. (auth)

50817 (LBL-958) SENSITIVITY OF SYNCHRONIZED MAMMALIAN CELLS TO HIGH LET RADIATION. Bird, Richard Putnam (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1972. Contract W-7405-eng-48. 93p. Dep. NTIS. Thesis.

Cultured Chinese hamster cells (V79) were irradiated with 145 kVp x rays and with high linear energy transfer (LET) radiations at different times in their synchronized cell cycle. The radiation effect scored was killing defined by colony-forming ability in a six-day growth period. The high LET radiations used were accelerated ions of ^{4}He, ^{12}C, ^{20}Ne, and ^{40}A with energies near that of the full energy available at the Berkeley HILAC (10 MeV/amu). The range of LET values was from about 2 keV/micron to 2000 keV/micron of unit density matter. In addition, asynchronous populations were irradiated with the above accelerated ions and with ^{10}B ions from the HILAC. Synchronized cultures were obtained by mitotic selection using a mechanical shaker. The degree of synchrony was primarily determined by autoradiographs of pulse-labeled (^{3}H-TdR) cultures and was found to vary from 0.5 to 0.8 in labeling index. Measurements of the cell nucleus cross-section were made also at different times after synchronization. With low LET radiations, the synchronized cultures exhibited a variation in the survival depending on the cell-cycle time of irradiation, as observed by others. The magnitude of this variation was found to be LET-dependent, decreasing with increasing LET until there was no measurable survival variation (or age-response) when radiations with LET values of 200 keV/micron and higher were used. The inactivation cross-sections determined for carbon, neon, and argon ion irradiation were 47, 71, and 98 (microns)^2, respectively, invariant to cell-cycle time. The cross-section measured for the cell nucleus increased from about 50 to 70 (microns)^2 for the usual cell cycle times of irradiation. Comparison of inactivation cross-sections with the cross-sections of the nucleus indicates that the whole nucleus is not uniformly sensitive at all cell cycle times. The age-response dependence on LET can be interpreted that the same radiation damage site is involved for low and high LET radiation. The possible application of the results to radiation therapy is discussed. (auth)

50818 OXYGEN ENHANCEMENT RATIO AS MEASURED WITH HeLa CELLS AND PROTRACTED IRRADIATION FROM ^{252}Cf AND ^{137}Cs. Drew, Ruth M.; Fairchild, Ralph G.; Atkins, Harold L. (Brookhaven National Lab., Upton, N. Y.). Radiology; 104: No. 2, 409-13(Aug 1972).

Oxygen enhancement ratio measurements are reported for protracted irradiation of human cancer cells in culture, using ^{252}Cf neutron sources and ^{137}Cs gamma-ray sources. A value of 1.55 was found for ^{252}Cf, which is in general agreement with other reported OERs; the value of 2.50 for ^{137}Cs is significantly higher than some previously reported. The therapeutic gain factor of 1.6 indicates that ^{252}Cf may yield an advantage in implant therapy. Glass flasks were used to obviate the problem of oxygen solubility in plastic flasks. Improvements in gassing procedures produced reasonably good survival in control cells under prolonged anoxia. (auth)

Radiation Effects on Microorganisms (External Source)

Refer also to abstracts 50673, 50800, 50804, 50805, 50811, 50815, 50833, 50834, and 50901.

50819 (AEC-tr-7316, pp 1-23) MATHEMATICAL MODEL STUDY OF THE RESPONSES OF CELLS TO IRRADIATION. Kapul'tsevich, Yu. G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 12: No. 1, 3-18(1972).

The work presents a quantitative analysis of the manifestation of various forms of responses to irradiation in yeast cells from the standpoint of classical models of the hit principle and the concept of biological stochastics. It was shown that not one of these conceptual systems is capable of explaining the entire variety of radiobiological effects recordable experimentally. A probability model is proposed for the responses of cells to irradiation, combining the hit principle and biological stochastics. According to this model, the amount of energy absorbed in the cell (the number of hits) does not strictly determine the death or survival of the cell, but induces some probability of nonrealization of division, which decreases with increasing number of hits and remains constant over a large number of cell generations. It was shown that the probability model satisfactorily describes the qualitative principles of the responses of various strains of yeast cells to irradiation. (tr-auth)

50820 (AEC-tr-7316, pp 123-33) ANALYSIS OF THE USE OF α PARTICLES FOR THE SUPPRESSION OF THE RECOVERY OF BACTERIAL CELLS. Petin, V. G.; Myasnik, M. N. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 12: No. 1, 85-91 (1972).

The system of radiobiological evidences of the role of recovery in the radioresistance of bacterial cells is analyzed in the work, on the basis of the assumption that α irradiation suppresses the repair systems of cells. The analysis of the experimental data presented showed that most of these evidences were found to be either artifacts, which appear as a result of methodological errors, or a consequence of insufficiently critical analysis. The theoretical calculations performed in the work also indicated that the probability of damage to the repair system of cells by α particles is negligible. (tr-auth)

50821 (EUR-4810(Vol.1), pp 305-16) EFFECT OF PULSE REPETITION RATE ON THE COLONY FORMING ABILITY OF DIPLOID YEAST EXPOSED TO 12-MeV ELECTRONS. Kiefer, Juergen (Justus Liebig-Univ., Giessen, Ger.); Howard, A.; Ebert, M.; Averbeck, D.

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The influence of dose distribution in time on the reproductive ability of yeast cells was studied. Saccharomyces cerevisiae cells were exposed to electrons from a 12 MeV-linear accelerator under hypoxic conditions. Five μsec pulses were delivered at repetition rates of 10 and 50 pulses per second. A significant increase in colony forming ability was found at the higher repetition rate. This effect was even more pronounced if the irradiation temperature was lowered to 0°C, but disappeared completely if the exposure took place at liquid nitrogen temperature. The experiments will be discussed with regard to theoretical considerations outlined at the preceding symposium. (auth)

50822 VARIATION IN UV SENSITIVITY OF FOUR K_{12} STRAINS OF ESCHERICHIA COLI AS A FUNCTION OF THEIR STAGE OF GROWTH. Tyrrell, Rex M.; Moss, S. H.; Davies, D. J. G. (Univ. of Bath, Eng.). Mutat. Res.; 16: No. 1, 1-12 (Sep 1972).

The uv response of four K_{12} strains of E. coli that differ in their repair characteristics was studied as a function of their stage of growth. The four strains used were AB_{1157} that possesses the full complement of repair genes, the excision-deficient AB_{1886} (uvrA-6), the recombination-deficient AB_{2463} (recA-13) and the excision- and recombination-deficient AB_{2480} (recA-13, uvrA-6). The uv sensitivity-growth phase profile of the double mutant showed a decrease in early exponential phase and then an increase to the original level by the start of stationary phase that remained unchanged up to 48 h. This decreased sensitivity was found to be associated with an increase in the shoulder of the full uv survivor curve. Deviations from the AB_{2480} profile shown by other strains reflect the influence of repair mechanisms on the uv-induced damage in cells, and indicate the influence that physiological changes occurring during different phases of the growth cycle have on the efficiencies of the repair systems. Since AB_{1886} showed a similar profile to AB_{2480}, it appears that postreplicatory recombination repair is unaffected by the intracellular changes. However, the recombination-negative AB_{2463} showed a marked increase in uv sensitivity throughout exponential growth followed by an increase in resistance that continued up to 48 h. It is postulated that this increased sensitivity in rapidly dividing cells results from a decreased repair efficiency due to a decrease in time before DNA replication takes place and also to a temporary decrease in numbers of repair enzyme molecules within the cells. The enzyme concentration increases in stationary phase and accounts for the enhanced recovery noted during this stage of growth. Results of experiments on preirradiation and postirradiation liquid holding of cells support this view. Studies with AB_{1157} indicate the interrelationship of excision and recombination, working sequentially, at different stages of the growth cycle. A comparison of the AB_{1157} results with those from single mutants indicate that while both processes are necessary for maximum cellular recovery, in most cases recombination can compensate for decreased excision repair efficiency. However, when excision efficiency falls below a certain limit, recombination can no longer fully cope with the partially repaired cells and an increased sensitivity results. Possible reasons for the interaction of these two dark repair processes are discussed. (auth)

50823 SPONTANEOUS AND RADIATION-INDUCED DELETION MUTATIONS IN ESCHERICHIA COLI STRAINS WITH DIFFERENT DNA REPAIR CAPACITIES. Ishii, Yutaka; Kondo, Sohei (Osaka Univ.) Mutat. Res.; 16: No. 1, 13-25(Sep 1972).

Deletion mutations (resistant to colicin B) were compared in Escherichia coli B strains that differ in DNA repair capacity; parental (with a B/r-type repair capacity), $uvrA^-$ or $uvrB^-$ (unable to excise pyrimidine dimers), pol^- (defective in DNA polymerase I activity) and $recA^-$ (defective in recombinational repair). Strains $uvrA^-$ and $uvrB^-$ showed about 20 times greater sensitivity to deletion mutations as well as to killing by uv compared with the parental strain. However, they showed almost the same sensitivity to deletion mutations as well as to killing by x-rays compared with the parental one. A $recA^-$ strain showed no significant increase in the deletion yield above the spontaneous level after uv or x irradiation. Two pol^- strains showed significantly higher deletion mutability to uv and x-rays than the parental strain. The rate (/cell division/bacterium) of spontaneous deletions was significantly higher in the two pol^- strains than in the parental, $uvrA^-$, $uvrB^-$, and $recA^-$ strains, whereas spontaneous rates among the latter strains showed no significant difference. The Col-B^R mutations were made of "short" (from colB to tonB locus) and "long" (from colB to trp locus) deletions. Almost all the induced mutations were "short" deletions, but spontaneous ones were made of "short" and "long" deletions in about a one-to-one ratio except for the pol^- strains, which had a short-to-long ratio of about 4 : 1. It is concluded that induction of deletion mutations by uv or x-rays requires not only pyrimidine dimers or x-ray damage to DNA but also participation of the recombination mechanism, and that the lack of DNA polymerase I activity may result in enhanced DNA errors which in turn lead to elevated deletion mutability. (auth)

50824 MACROMOLECULAR SYNTHESES AND MITOSIS IN UV-IRRADIATED PLASMODIA OF PHYSARUM POLYCEPHALUM. Devi, Vimala R.; Guttes, Edmund (Univ. of Texas, Dallas). Radiat. Res.; 51: No. 2, 410-30(Aug 1972).

In the multinucleated plasmodia of the myxomycete Physarum polycephalum, irradiation with ultraviolet light delays the first postirradiation mitosis and the intervals between several subsequent mitoses are shorter than in unirradiated controls. In order to obtain more information on the factors involved, plasmodia were placed, at different times after irradiation, on media containing actinomycin (inhibition of RNA synthesis), cycloheximide (inhibition of protein synthesis), 5-fluoro-2′-deoxyuridine (inhibition of DNA synthesis), or nonnutrient balanced salt solution (total starvation). Sensitivity of the plasmodia to mitotic delay produced by actinomycin decreased rapidly after uv irradiation and reached approximately zero at the time when the nuclei would have divided if the plasmodia had not been irradiated. Following the first postirradiation mitosis, the plasmodia remained almost insensitive to continuous exposure to actinomycin for several mitotic cycles. Starvation of the irradiated plasmodia by transfer to nonnutrient balanced salt solution likewise failed to affect mitosis appreciably, whereas mitosis was considerably delayed by the same treatment in nonirradiated plasmodia. Sensitivity to cycloheximide and 5-fluoro-2′-deoxyuridine was approximately the same in the irradiated plasmodia as in unirradiated controls. At the time of the first postirradiation mitosis in the irradiated plasmodia, total protein and RNA per plasmodium were greater than the amounts present in the controls at the time of the undelayed mitosis. In plasmodia irradiated during G_2 phase, the amount of DNA per plasmodium decreased before the first postirradiation mitosis, remained about the same between the first and second mitosis, and rapidly increased thereafter. The mitotic cycles succeeding the first mitosis were shorter than the corresponding cycles in controls. A considerable number of degenerating nuclei was found in sections of irradiated plasmodia. It is suggested that the abbreviation of mitotic cycles following the first postirradiation mitosis, decreased sensitivity to actinomycin and to starvation, and pycnotic degeneration of large numbers of nuclei are interrelated phenomena. (auth)

50825 RADIORESISTANCE OF THE VIRUS OF A MURINE MAMMARY TUMOR EXPOSED TO GAMMA RADIATION. Mouriquand, Jacqueline; Mouriquand, Claude; Mistry, Perine; Gorka, Claude (CEN, Grenoble, France). Compt. Rend., Ser. D; 274: No. 15, 2259-62(10 Apr 1972). (In French).

Acellular extracts from mammary tumors were exposed to γ radiation (direct exposure to doses between 150 and 1950 kR). Biological tests demonstrated the existence of an enhanced infectivity at 1200 kR. At the maximum dose (1950 kR), the infectivity was still greater than with the reference samples but there was a decrease in the latency period. (France)

50826 BACTERICIDAL, SPORICIDAL, AND VIRUCIDAL EFFECTS OF γ RAYS DELIVERED AT DIFFERENT DOSE RATES. Andryunin, Yu. I. Vestn. Sel'skokhoz. Nauki (Moscow); No. 7, 145-6(1971). (In Russian).

Suspensions and dry preparations of Streptococcus apis, spore-forming Bacillus larvae, and foot-and-mouth disease virus were irradiated with 1 million R of gamma rays at the rates of 1,000, 10,000, and 22,560 R/min, and the survival of the microbes was determined by growing cultures (Strep. apis and Bac. larvae) and by assaying the ID_{50} on guinea pigs (virus). The results revealed no significant differences in the survival of microorganisms depending on the dose rate. It is concluded that no changes need be introduced in the routine industrial irradiation of food products for the purpose of sterilization. (JPRS)

50827 INDIRECT INDUCTION OF ESCHERICHIA COLI K 12 S (λ) HCR^+ AND HCR^- BACTERIA BY HOST-MODIFIED λ B PHAGES. Scherneck, S.; Theile, M.; Geissler, E. (Univ., Rostock, Ger.). Z. Allg. Mikrobiol.; 11: 331-45(1971). (In German).

Through superinfection with host-modified λ B phages, indirect induction occurs of nonirradiated as well as uv-irradiated Escherichia coli K 12 S (λ) HCR$^+$ and HCR$^-$ bacteria. Such an indirect induction in HCR$^+$ and HCR$^-$ cells depends on the radiation dose to the phages. The efficiency of indirect induction by host-modified phages is lower than by direct ultraviolet induction. Indirect induction cannot be demonstrated with E. coli K 12 bacteria. To explain the findings, a special hypothesis is proposed. (tr-auth)

50828 PHOTOPROTECTION FROM KILLING IN ULTRAVIOLET-SENSITIVE ESCHERICHIA COLI K-12 MUTANTS. INVOLVEMENT OF EXCISION-RESYNTHESIS REPAIR. Lakchaura, B. D. (Univ. of Texas, Dallas). Photochem. Photobiol.; 16: No. 3, 197-202(Sep 1972).

Certain cells become more resistant to the lethal action of far-ultraviolet radiation (254 nm) if they are pre-illuminated with near-ultraviolet light (300 to 380 nm). This phenomenon is termed photoprotection (PP). The mechanism proposed for PP involves temporary inhibition of normal growth that extends the period in which existing cellular dark-repair systems may operate. The photoprotectability of mutants of Escherichia coli K-12 was investigated and it was found that only uvr$^+$rec$^-$ mutants exhibit PP, although both these and uvr$^-$rec$^+$ cells undergo nearly the same extent of growth inhibition upon near uv irradiation. These results indicate that PP utilizes the excision-resynthesis repair system and does not utilize the recombination-repair system. (auth)

50829 EFFECTS OF 5-FLUOROURACIL AND PANTOYL LACTONE ON VIABILITY AND DIVISION OF ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI FIL$^+$ AND FIL$^-$. Swenson, P. A.; Schenley, R. L.; Boyle, J. M. (Oak Ridge National Lab., Tenn.). J. Gen. Microbiol.; 71: No. 3, 567-74(Aug 1972).

Escherichia coli strains B Hill(FIL$^+$) and B/r(FIL$^-$), when grown on minimal medium containing glycerol, ceased respiration for several hours after ultraviolet (uv) irradiation at 520 ergs/mm^2. Treatment of cells with 5-fluorouracil (FU) had two effects on viability: pre-irradiation treatment enhanced survival of E. coli B Hill(FIL$^+$) but not that of B/r(FIL$^-$) when survival was measured immediately after irradiation; and pre- or postirradiation treatment of either strain resulted in a large and rapid increase in viability over the first hour of postirradiation incubation. Postirradiation treatment with pantoyl lactone (PL) resulted in a moderate increase in viability, but maintenance of growth and respiration was favored only by FU. Postirradiation treatment with FU and PL together produced kinetics of respiration, growth, and viability intermediate between those observed when the drugs were used separately. Irradiated B Hill organisms, which usually form filaments after uv irradiation, only did so in glycerol medium when FU was present. If FU was then replaced by PL, the filaments broke up and viability increased. Viability of B Hill was always higher when irradiated bacteria were plated on agar containing PL than without PL. Thus the increased viability caused by PL and FU when present singly during postirradiation incubation occurred by different means: PL by stimulation of division, and FU by maintenance of respiration. (auth)

Radiation Effects on Plants (External Source)

Refer also to abstracts 50798 and 50901.

50830 (AEC-tr-7316, pp 207-13) INFLUENCE OF CHRONIC GAMMA IRRADIATION ON CHLORELLA. Shabanova, E. A. (Inst. of General Genetics, Moscow). Translated from Radiobiologiya; 12: No. 1, 140-4(1972).

In the irradiation of Chlorella vulgaris Beyer, strain LARG-1 with γ rays in small doses (150, 300, 450, and 750 rad) at a rate of 50 to 75 rad/day, a significant increase in the number of visible mutations was obtained. Storage of the irradiated material in the inactive state (G_1 stage) revealed a wave-like variation of the level of mutability. A determination of the mutagenic effectiveness of irradiation (the number of mutations per rad per $1 \cdot 10^6$ cells) indicated that in the first day of storage the most effective dose is 150 rad; with increasing time of storage after irradiation, the effectiveness of the action of large doses of radiation increases. (tr-auth)

50831 (AEC-tr-7316, pp 214-19) INTERCELLULAR INTERACTIONS AND RECOVERY OF A POPULATION OF THE BLUE-GREEN ALGA PLECTONEMA BORYANUM AFTER GAMMA IRRADIATION. Golubkova, M. G.; Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). Translated from Radiobiologiya; 12: No. 1, 144-8(1972).

The recovery curves of a cell population of the blue-green alga Plectonema boryanum after γ irradiation at a dose of 500 krad were studied. It is suggested that the population of Plectonema boryanum is heterogeneous with respect to the radiosensitivity of the individual subpopulations, and the interrelationship among the latter is accomplished through the action of substances excreted into the medium by the cells themselves. (tr-auth)

50832 (CNEA-310) APPLICATION OF GAMMA RADIATION TO POTATO PRESERVATION. Pahissa Campa, J.; Hercovich de Pahissa, M. H.; Gabarain, R. V. A.; Tramontini, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 16p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Potatoes of the Huincul and Kennebec varieties that were stored for 2 to 3 months after harvesting were γ-irradiated at doses of 3, 6, 8, 10, 15, and 25 Krad. No significant differences were found between the irradiated tubers and nonirradiated tubers when analyzed for changes in morphology, weight, moisture content, and chemical composition. Twenty days after exposure, the irradiated tubers were favored over nonirradiated tubers in taste tests. This preference increased with time. It was concluded that the quality of potatoes could be retained while sprouting could be inhibited for periods of 6 to 7 months storage at room temperature following γ irradiation. (E.R.B.)

50833 (COO-3217-4) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). 1 Jul 1972. Contract AT(11-1)-3217. 114p. Dep. NTIS.

Research activities during the year ending on June 30, 1971 on the application of nuclear energy to agriculture involved the following projects: mutation breeding and radiation botany; control of insects by male sterilization method; radiobiology in insect pathology; and soil chemistry studies. The results of mutation breeding studies in Manihot sp., Coffea arabica, and Phaseolus vulgaris are given. The results of studies on the radiosensitivity of tropical species of the Compositae and Cruciferae families are given as a function of chronic dose. The effects of sterilization on the mating competitiveness of the male medfly and coffee leaf miner were studied; results of these studies are given. In studies on the pathological control of insect pests, the susceptibility of larvae of the shootborer and the Torsalo fly to pathogenic bacteria and fungi was determined. Radiation mutagenesis experiments were conducted to select mutants of these insect pathogens for both increased survival capacity and increased pathogenicity. In the soil chemistry studies, the cation exchange properties and the zinc adsorption capacity of volcanic ash soils were determined. (E.R.B.)

50834 (COO-3217-5) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Triennial Report, July 1, 1969–June 30, 1972. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). 1972. Contract AT(11-1)-3217. 251p. Dep. NTIS.

ANGIOSPERMIDAE — Coffea arabica (coffee), radioinduced semi-dwarf compact mutations in, following seed exposure, breeding potential of γ
  — Manihot sp. (casoava), radioinduced somatic mutations in, following pollen exposure, effects of dose on frequency of γ
  — Phaseolus vulgaris (common bean), mutation breeding in, field trials, nutrition studies, and screening methods for
  — Phaseolus vulgaris (common bean), mutations induced in, by cycasin
  — radiosensitivity of tropical species of the families Compositae and Cruciferae under conditions of chronic low dose rate exposure, γ
BACTERIA — Bacillus thuringiensis, radiation effects on survival of pathogenic strains of, comparison of effects of dose on uv
FALLOUT — monitoring in rainfall of Costa Rica, cooperative program for
FUNGI — Metarrhizium anisopliae, radioinduced mutations in spores of, for enhanced survival and pathogenicity to insect pests, effects of age, dose, and spore concentration on frequency of γ and uv
INSECTA — Ceratitis capitata (medfly), radioinduced sterility in male, exposed as adults or pupae, mating competitiveness of males following γ
  — Ceratitis capitata (medfly), radioinduced visible mutations in adult male, for monitoring eradication program, γ
  — Dermatobia hominis (Torsalo fly), susceptibility of larvae of, to Bacillus thuringiensis
  — Hypsipyla grandella (shootborer), growth of larvae of, on synthetic diet
  — Hypsipyla grandella (shootborer), susceptibility of larvae of, to Bacillus thuringiensis and Metarrhizium anisopliae
  — Hypsipyla grandella (shootborer), susceptibility of larvae of, to Beauveria bassiana and Beauveria tenella

—Leucoptera coffeella (coffee leaf miner), radioinduced sterility in adult male, inherited sterility and mating competitiveness in male progeny following γ
—Leucoptera coffeella (coffee leaf miner), radioinduced sterility in adult male, mating competitiveness of males following γ
SOILS—aluminum extraction from volcanic ash
—cation exchange properties of clay minerals from volcanic ash
—phosphate chemistry in tropical
—phosphate fertilizers in volcanic ash, reactions and efficiency of
—trace elements in, of Brazil
—zinc absorption from volcanic ash, by maize plants
—zinc adsorption in volcanic ash (E.R.B.)

50835 (EUR-4810(Vol.1), pp 345-70) RBE OF A BEAM OF 15-MeV ELECTRONS AS A FUNCTION OF THE MODIFICATIONS OF ITS ENERGY SPECTRUM WITH DEPTH DETERMINED BY THE STUDY OF THE RADIOINDUCED CHROMOSOME ABERRATIONS IN ALLIUM CEPA. Wambersie, A.; Bouharmont, J.; Lellouch, J.; Prignot, Michelle; Lamotte, Mariette (Univ., Louvain, Belg.). (In French).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The RBE of 15 MeV electrons at the surface and in depth compared to ^{60}Co was determined using radiation-induced chromosomal aberrations in onion roots (Allium cepa) as biological criterion. Dosimetry was based on $FeSO_4$. No significant difference in RBE was found between the three compared radiation qualities (15 MeV electrons at the 100% isodose level, at the 33% isodose level, ^{60}Co). These results confirm our previous conclusions obtained from experiments with microorganisms and mice. However, it seems difficult by counting chromosomal aberrations to demonstrate differences in RBE of the order of 10 or even 15% that could have a practical significance in radiation therapy. These experiments show that the percentage of fragments (or of cells in anaphase or telophase with fragments) is the only possible criterion for an RBE study. The percentage of bridges in anaphase does practically not increase as a function of dose, at least for our material and in our conditions and the percentages of the other types of aberrations are too small. (auth)

50836 INDUCTION OF MUTATIONS IN CULTIVATED RICE BY CHEMICAL AND PHYSICAL AGENTS. I. THE EFFECTS OF ISOPROPYL METHANESULFONATE, DIETHYL SULFATE, AND GAMMA RADIATIONS ON SEED GERMINATION AND SEEDLING HEIGHT INJURY. Woo, Shiu-chu; Ng, Chi-ming; Tye, Ee-mooi (Inst. of Botany, Taipei, Taiwan). Bot. Bull. Acad. Sinica (Taiwan); 12: No. 1, 10-23(Jan 1971).

Indica rice, IR-8, and japonica rice, Chianung 242, were treated with the chemicals isopropyl methanesulfonate and diethyl sulfate as well as gamma irradiation. Mutagen solutions were buffered at pH 3, 7, 9, and 11 levels. Isopropyl methanesulfonate did not induce significant seedling height injuries, but, a number of chlorophyll mutants were found at the M_2 seedling stage. Diethyl sulfate caused severe damage with mutagen solutions buffered at pH 3 and 7. Those buffered at pH 11 stimulated seedling growth. Gamma irradiation also gave significant damage to seedling growth; nevertheless, seed germination was little affected. (auth)

50837 ACCELERATION OF NUCLEAR GROWTH AND ADVANCED INITIATION OF MITOSIS IN u.v.-IRRADIATED PLASMODIA OF PHYSARUM POLYCEPHALUM. Telatnyk, M. M.; Guttes, E. (Univ. of Texas, Dallas). J. Cell Sci.; 11: No. 1, 49-58(Jul 1972).

In the multinucleated plasmodia of Physarum polycephalum the intermitotic period lasts from 2.5 to 5 days on diluted (1 : 8) growth medium and 3 to 7 days on non-nutrient balanced salt solution. When such plasmodia were irradiated with u.v. light approx. 15 to 20 h after mitosis, the next mitosis was considerably advanced and the intermitotic period lasted only between 36 and 48 h. During this time, numerous nuclei became pyknotic and disappeared, while the others became larger than in unirradiated controls. It is proposed that the abbreviation of the intermitotic period preceding the first post-irradiation mitosis was caused by incorporation into the surviving nuclei of a substance(s) which was released from the degenerating nuclei. (auth)

50838 EFFECTS OF LOW DOSES OF X-RAYS ON ROOTING AND YIELD OF CARNATION. Bors, J. (Technische Univ., Hanover); Zimmer, K. Stimulation Newslett.; No. 1, 15-17 (1970).

Unrooted and 4-week old rooted cuttings were irradiated with 10–600 R of x-rays at a dose rate of 2,500 R/hr, or with 600 R–10 KR of ^{60}Co γ-rays at a dose rate of 3×10^5 R/hr. An examination of radiation effects was performed at different growth stages. The number and length of roots, dry weight of shoots, time of flowering, number and size of flowers and length of internodes and stems was recorded. Higher radiation doses prevented or delayed the rooting, whereas low doses from 80 to 600 R stimulated it. In rooted cuttings, irradiation delayed the growth and high doses lead to greater damage. (GF)

50839 RADIATION: STIMULATION OF TOMATOES. Menyhert, Z. (Agrartudomanyi Egyetem, Godollo, Hungary). Stimulation Newslett.; No. 1, 17-20(1970).

Tomato seeds of different varieties were irradiated with 50 R to 50 KR of ^{60}Co γ-rays at a dose rate 475 R/hr. The height and size of vegetative parts of irradiated plants was compared with those of controls. Between 150 R and 10 KR, a significant stimulation of growth was found, especially in the earlier growth stage. An increase of yield up to 52% was achieved with the irradiated plants, but only in the first period of harvest, later the difference from the controls decreased. This enhancement of yield was due to an increase of the number but not of the weight of tomatoes. (GF)

50840 PRELIMINARY RESULTS OF X-RAY APPLICATION ON GRAPE SEEDS. Coutinho, M. P. (Univ. Tecnica, Lisbon). Stimulation Newslett.; No. 2, 1-4(1971).

Grape seeds of 2 varieties were treated with x rays before sowing. The percentage of germination was determined by counting the seedlings in each group. Doses up to 5,000 rads stimulated the germination, higher doses above 10,000 rads prevented it. Furthermore, an increase of height of young plant was recorded up to 5,000 rads. (GF)

50841 GAMMA STIMULATION OF POTATO TUBERS. Caldera, P. G. (Gammaton S.p.a., Guanzate, Italy). Stimulation Newslett.; No. 1, 6-7(1970).

Potatoes were irradiated with 100 to 600 rads of γ-rays 16 d before seeding. At the harvest, the number of potatoes per parcel, the number of potatoes usable commercially and the total yield was evaluated. Comparison of weight with controls showed an increase, especially after irradiation with 100 rads. (GF)

50842 SOMATIC MUTATIONAL TRANSIENTS: MODELS OF RESPONSE TO ACUTE AND DISTRIBUTED DOSES OF RADIATION APPLIED TO GROWING PLANTS. Sand, Seaward A. (Roswell Park Memorial Inst., Orchard Park, N. Y.). Proc. Nat. Acad. Sci. U. S. A.; 69: No. 8, 2229-32(Aug 1972).

After limited exposures of whole plants to gamma radiation, the induced-mutation frequency, measured in somatic tissue of successively blooming flowers, is a transient function of time. Quantitative interpretation of the data is aided by construction of a cell-generation model. Seven theoretical models are designed to represent interaction between the cell-generation model and seven different modes of application of the radiation treatment. The models provide a structure for integration of the mutational contributions from different floral primordia. These different contributions are distributed over the array of mature flowers by the quantitative relationships of each model. A mathematical expression for the average response of a model can be equated to the average observed response and solved for the implied mutation rate per cell per roentgen. (auth)

50843 SOME EFFECTS OF IONIZING RADIATION ON PLANT PHYLLOTAXIS. Gomez-Campo, C.; Casas-Builla, M. (Instituto Nacional de Investigaciones Agronomicas, Madrid). Radiat. Bot.; 12: No. 3, 165-72(Jul 1972).

Among M_2 seedlings from chronically irradiated Helianthus annuus parents (60 to 120 rad/day) tri-cotyledony and syncotyledony were frequent. Tri-cotyledonous seedlings were followed in most cases by three-fold phyllotaxis. Dicotyledonous plantules also showed trimerous verticilles in a certain proportion, though, more commonly, they were decussate with a shorter number of verticilles as related to the controls. Chronic γ-irradiation (10 to 160 rad/day) strikingly disturbed the normal pattern of right-left asymmetries in the collateral axils of Ecballium elasterium. The frequency of axils with an opposite handedness to that prevailing in the same branch, was increased. For the higher dose rates, symmetrical axillary formations became frequent. After acute irradiation of Helianthus or Ecballium seeds, none of the above effects was significant. (Helianthus seeds were irradiated with doses of 0, 5, 10, 20, and 40 Krad of γ rays. Ecballium seeds were irradiated with doses of 20 Krad of γ-rays or thermal neutrons.) Some other radiation-induced phyllotactic disturbances on Olea europaea and Chamaecereus silvestri are described. The production of more disordered or randomized patterns is to be expected in irradiated material, but trimerous phyllotaxis in sunflower and symmetrical axils in Ecballium provide at least two apparent exceptions. Their possible significance is discussed. (auth)

50844 RADIATION INDUCED LEAF STIPPLING IN PHASEOLUS VULGARIS L. cv. BLUE LAKE FOR ESTIMATING RADIOSENSITIVITY. Mujeeb, K. A. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 340-1(Jul 1972).

The effects of γ irradiation doses of from 1.0 to 7.5 kR from a 4500 Ci ^{60}Co γ source to the seed of Phaseolus vulgaris L cv Blue Lake on the total chlorophyll content of the primary leaves were investigated. Enhanced radiation dosages resulted in seedlings with primary leaves of a decreased size and increased coarseness and it was noted that the stippling of these leaves was positively correlated with dosage. This latter effect is considered to afford an accurate method of estimating seed radiosensitivity. (UK)

50845 IRRADIATION EFFECT ON ALFALFA IN M_1. Ciurdarescu, G.; Banu, M.; Varga, P.; Diaconu, P. An. Inst. Cercet. Pentru Cereale Plante Teh.-Fundulea, Ser. C; 36: 335-43(1968). (In Rumanian).

Alfalfa seeds (2n = 32), belonging to the H 652 and F27/55 varieties were irradiated with gamma radiation in 10, 20, 30, and 40 kR doses and with thermal neutrons in 6.55×10^{12}; 5.61×10^{13}, and 2.49×10^{14} doses. The gamma radiation had a non-significant stimulant effect on plant development and on their survival in the field. The F 27/55 variety proved resistant to the action of the gamma radiation in the field and after mitotic analyses. Thermal neutrons induced a decrease in plant development and in survival; cytologically they induced chromosomal aberrations with a higher frequency than did gamma radiation. The H 652 variety proved most radiosensitive. (auth)

50846 MORPHOLOGICAL RESPONSES OF LIRIODENDRON TULIPIFERA L. SEEDLINGS TO ACUTE FAST NEUTRON RADIATION AND REDUCED LIGHT. Harris, W. F. (Oak Ridge National Lab., Tenn.). Radiat. Bot.; 12: No. 3, 205-19(Jul 1972).

Dormant seedlings of yellow poplar (Liriodendron tulipifera L.) were irradiated acutely with fast neutron radiation from an unshielded fast reactor and grown postirradiation in light environments of 100, 50 and 25% sunlight. Several morphological responses were monitored for a period of up to two growing seasons with the objectives of determining the separate and interacting effects of ionizing radiation and reduced light. Morphological responses measured were: diameter increment, terminal and lateral growth, and bud formation. Terminal and lateral bud mortality and complete stem kill were independent of reduced light treatments. Other parameters examined were found to interact variously with responses to reduced light. Terminal growth of the seedlings was independent of reduced light at a dose higher than 300 rad. Below 300 rad, terminal growth was stimulated. Growth of lateral shoots was increased following irradiation and shading, but the same treatments decreased the number of lateral buds developing per seedling—differences in total lateral growth among radiation doses were undetectable because of the interacting responses. (auth)

50847 STUDY OF A MEDITERRANEAN TYPE PHYTOCENOSE SUBJECTED TO CHRONIC GAMMA RADIATION. Fabries, M. (CEN de Cadarache, Saint-Paul-les-Durance, France); Grauby, A.; Trochain, J. L. Radiat. Bot.; 12: No. 3, 125-35(Jul 1972).

A phytocenose of a natural Mediterranean ecosystem (wood and garrigue), undisturbed by man for over 30 yr, has been subjected to chronic gamma radiation (source ^{137}Cs, 1200 Ci) since July 12th, 1969, at the Nuclear Research Center at Cadarache, S.E. France. Results obtained up till the date of writing agreed with the results obtained on different types of ecosystems, at least in the fields of morphology (leaf malformation and stem shortening), anatomy (meristem inhibition, tissue distortion), and radiosensitivity (the herbaceous plants are more resistant than ligneous plants). The surviving foliage that had grown before the radiation began displayed a high radiosensitivity in general, and thallophytes (lichens) showed an increased rate of growth in the space left free by the death of higher plants (especially ligneous plants). Typical Mediterranean species were more resistant, while the submediterranean species appeared more sensitive; this was apparent in the classification of the species by degree of sensitivity. It appeared that the ecological environmental characteristics were as important as the standard factors already known, if not more so, in determining a plant's radiosensitivity. (auth)

50848 ANALYSIS OF A CASE OF MUTAGEN SPECIFICITY IN NEUROSPORA CRASSA. IV. INTERACTIONS BETWEEN UV AND THREE CHEMICAL MUTAGENS. Auerbach, C.; Ramsay, D. (Inst. of Animal Genetics, Edinburgh). Mol. Gen. Genet.; 117: No. 1, 1-13(1972).

In the strain ad 3A 38701 inos 37401, ultraviolet radiation (uv) usually produces about twice as many inositol-as adenine-reversions. We have shown previously that this inositol-specificity of uv can be reversed into adenine-specificity by pre- or post-treatment with low doses of the adenine-specific diepoxybutane (DEB). We now have tested two more adenine-specific mutagens, nitrous acid (NA) and a mixture of hydrogen peroxide and formaldehyde (HF) and one inositol-specific mutagen nitrosoethylurethane (NEU) for interaction with uv. The former two substances behaved like DEB in reversing the inositol-specificity of uv when given as pre- or post-treatment. Pre-treatment with NEU always enhanced the frequency of inositol-reversions beyond additivity. At low doses, it also enhanced the frequency of adenine-reversions. The results are discussed in relation to mutagen specificity. They indicate that specificity may arise from the effects of treatment on cellular events in any one of the three major parts of the mutational pathway: repair, expression, or growth of completed mutants into clones. (auth)

50849 BASE-CHANGE MUTABILITY TOWARD UV OF ESCHERICHIA COLI STRAINS WITH DEFECTIVE DNA POLYMERASE. Ichikawa, Haruko; Kondo, Sohei (Osaka Univ.). Jap. J. Genet.; 47: No. 3, 203-6(Jun 1972).

The frequency of uv-radioinduced base-change mutations was compared in two DNA polymerase-defective strains of Escherichia coli. One strain was suppressible, the other was non-suppressible. In order to minimize the effect of variation in uv-radiosensitivity (for survival), induced mutations were observed in a low dose range. The results revealed no difference in the frequency of base-change mutations between the suppressible and non-suppressible strains. (E.R.B.)

50850 INTERRELATIONSHIP OF THE X-RAY INDUCED MUTATIONS IN AN INDICA RICE VARIETY HR5. Narahari, P. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 41: No. 16, 603-4(20 Aug 1972).

The interrelationship of the mutant genes in six x-ray induced mutations in the indica vice variety HR5 was studied. The progeny of five different crosses of the six mutants was studied for segregation behavior. From the resemblance of F_1 plants to HR5 and the digenic nature of the F_2 segregation pattern, it was concluded that the mutant genes were not linked to each other. (E.R.B.)

Radiation Effects on Animals (External Source)

Refer also to abstracts 50370, 50435, and 50539.

Man

Refer also to abstracts 52230, 52411, 52545, and 52687.

50851 (ABCC-TR-10-71) MORTALITY AMONG A-BOMB SURVIVORS, 1950–70. Report 6. Jablon, Seymour; Kato, Hiroo (Atomic Bomb Casualty Commission, Hiroshima (Japan). Atomic Bomb Casualty Commission, Nagasaki (Japan)). 21 Jul 1971. 331p. (In English and Japanese). Dep. NTIS.

Results are reported from an epidemiological survey of mortality among A-bomb survivors of Hiroshima and Nagasaki from 1950 to 1971. Tabulations were made on mortality from all causes and for 18 specific causes and groups, including all diseases, all malignant neoplasms, leukemia, tuberculosis, cardiovascular system diseases, diseases of the central nervous system, and trauma. An attempt was made to relate the estimated radiation dose (in rads) received at various ages to the mortality data. The results showed that morbidity from all diseases was higher among the survivors who had received large radiation doses than among those with small radiation doses or the general population. Those survivors who were children under 10 years of age at the time of exposure were more strongly affected than older persons. The radiation effect was especially prominent for leukemia, where it appeared to be present in those estimated to have received a dose as low as 10 to 49 rad. Mortality from other neoplasms was elevated in the survivors, but could only be demonstrated with reliability in those receiving doses exceeding 200 rad. It was concluded that the data are too sparse to support any radiation dose-response relationships for man, especially at low dose levels. (C.H.)

50852 (BARC/I-141) SUMMARY OF PERSONNEL RADIATION EXPOSURES IN BARC FOR THE PERIOD 1953–1965. Watamwar, S. B.; Bhargava, Y. B. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 40p. INIS.

The report gives a summary and analysis of radiation exposure data, both external and internal, for personnel working in the various facilities of the Bhabha Atomic Research Centre, Bombay, for the period 1953 to 1965. The data presented in the report depict the radiation exposure pattern due to various activities in the radiation work at the Centre. It is pertinent to note that the average annual dose per radiation worker has remained within a short range of 0.2 to 0.4 Rem. (INIS)

50853 (CONF-710304-14) RADIOSENSITIVITY AND RECOVERY POTENTIAL OF HUMAN BLOOD-FORMING TISSUES: COMPARISON OF MALIGNANT AND NONMALIGNANT STATES. Yuhas, John M. (Oak Ridge National Lab., Tenn.); Stokes, Thomas R.; Lushbaugh, C. C. (Oak Ridge Associated Universities, Inc., Tenn.). 1970. 16p. Dep. NTIS.

From Symposium on natural and manmade radiation in space; Las Vegas, Nev. (1 Mar 1971).

The peripheral white blood cell response in patients exposed to total-body fractionated or single dose γ or x radiation therapy for one of four diseases: chronic myelogenous leukemia, chronic lymphatic leukemia, lymphosarcoma, and diseases which have no direct effects on the blood-forming tissues, was studied. By using the white blood cell count at its nadir as a function of both exposure and protraction time it was determined that no significant differences exist among the four disease states in terms of the radiosensitivity of those tissues which give rise to the peripheral white blood cells. In contrast, the recovery potential of the patients with lymphatic neoplasms was threefold lower than that of the patients with a disease not directly affecting the blood-forming tissues. These data support, therefore, the proposal that fractionation of the total exposure can preferentially allow recovery of normal tissues, at least in the limited sense studied. (auth)

50854 (CONF-720607-17) COMPARISON OF RADIATION EXPOSURE OF THE POPULATION FROM MEDICAL DIAGNOSIS AND THE NUCLEAR ENERGY INDUSTRY. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.). 1972. 39p. Dep. NTIS.

From 18th annual American Nuclear Society conference; Las Vegas, NV. (18 Jun 1972).

Data are reviewed on the relation of radiation dose to the induction of genetic mutations; neoplasms, including leukemia; life shortening; and other pathological changes in animals and man. Data from surveys conducted by the U. S. Public Health Service on the radiation dose to man during diagnostic chest or dental radiography are discussed. Steps to reduced unnecessary medical exposures to x rays are outlined. The relative insignificance of the radiation dose to the human population as a result of exposure due to nuclear industry is compared to the dose received during medical diagnostic procedures. (C.H.)

50855 (COO-3428-1(Vol.3)) RADIATION PROTECTION STANDARDS: QUO VADIS. VOLUME III. STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. PART I. METHODOLOGY AND SOME PRELIMINARY FINDINGS LIMITED TO MORTALITY FOR HANFORD EMPLOYEES. Proceedings of the Sixth Annual Health Physics Society Topical Symposium, Richland, Washington, November 2-5, 1971. Mancuso, Thomas F.; Sanders, Barkev S.; Brodsky, Allen (Pittsburgh Univ., Pa. Dept. of Occupational Health). [nd]. Contract AT(30-1)-3394. 203p. (CONF-711119-(Vol.3)). Dep. NTIS.

Methodology used in an epidemiological study on the possible effects of biological injury from occupational low-level radiation exposure on AEC contractor personnel is described. Early retirement, disability, and death were used as the criteria for biological injury. Basic personnel, radiation exposure, work history, and environmental data were collected from the employment site and information obtained from the Social Security Administration was used to determine the cause and time of death. Mortality patterns were compared with Life Tables for the US general population. Some preliminary findings limited to mortality data on Hanford employees are presented. No correlation of the mortality data with radiation exposure was attempted. (C.H.)

50856 (EUR-4810(Vol.1), pp 317-44) MICRODOSIMETRY AND FORMATION OF DICENTRIC CHROMOSOMES IN LYMPHOCYTES IRRADIATED IN VITRO. Chmelevsky, D.; Chemtob, M.; Parmentier, N. C. (CEN, Fontenay-aux-Roses, France). (In French).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The reliability of the use of the number of dicentric chromosome aberrations in cultured lymphocytes as a biological dosimeter for humans following exposure to γ irradiation or mixed γ-neutron irradiation was evaluated. An experimental study was conducted on cultured lymphocytes of swine exposed to various doses of γ or mixed γ-neutron irradiation. It is pointed out that human lymphocytes have 46 chromosomes and those of swine have 38 chromosomes. Methods used for the preparation of lymphocyte cultures and for examination of the cells for chromosome changes are described in detail. In the case of exposure to mixed γ-neutrons the contribution of the γ dose was measured using LiF thermoluminescent dosimeters and the contribution of the neutron dose was calculated using the distribution of neutron fluence as a function of energy and activation detectors. Available data are tabulated on the number of dicentric chromosomes per cell observed in cultured lymphocytes from irradiated humans and are compared to the findings on lymphocytes from swine following exposure to various doses of γ or mixed γ-neutron radiation. Results indicated that the dose-response relationships following exposure to a ^{60}Co γ source were more reliable than following exposure to a mixed γ-neutron source. (C.H.)

50857 (FRNC-R-10) BIOLOGICAL DOSIMETRY OF MAMMALS AND MAN SUBJECTED TO IONIZING RADIATIONS. Marble, Georges (Centre de Recherches du Service de Sante des Armees, Percy (France). Division de Radiobiologie Experimentale). Jul 1971. 117p. (In French). Dep. NTIS (U. S. Sales Only).

The limitations of physical dosimetry and the need for using biological dosimetry became apparent from a study of lethal doses, the effect of dose rates, the RBE of radiations, radioprotection, and medical treatment. The biological damage caused by irradiation was quantitatively estimated by measuring the variations produced in the biological parameters (such as clinical observations, and cytogenetic, hematologic, biochemical and neurophysiological effects, and biophysical changes) of irradiated mammals and man. Radiation-induced biological variations which can be used in biological dosimetry were investigated. (France)

50858 (TID-3319(Suppl.4)) NUCLEAR MEDICINE. Bibliography from Nuclear Science Abstracts, Volume 25. (Technical Information Center (AEC), Oak Ridge, Tenn.). Jul 1972. 311p. Dep. NTIS.

Annotated citations are presented for 1151 literature items in the fields of clinical and experimental radiodiagnosis and radiotherapy for which abstracts were included in Nuclear Science Abstracts, Volume 25 (1971). Corporate author, personal author, subject, and report number indexes are included. (E.R.B.)

50859 (TID-25857, pp 92-103) PUBLIC AND RADIATION FROM NUCLEAR POWER PLANTS. Bond, Victor P. (Brookhaven National Lab., Upton, N. Y.). 1972.

In Environmental and ecological forum, 1970-1971.

The development of radiation protection standards in the USA is reviewed. It is pointed out that in the mid-fifties the National Academy of Sciences established a series of committees to investigate the biological effects of ionizing radiations and in 1956 the committee on genetic effects issued its report that included the recommendation that, on the basis of potential genetic effects, the total human population should receive no more than 10 rem over a 30-yr period, which was taken as the mean reproductive age of human beings. The value of 10 rem was intended to cover exposure from all man-made radiation sources, including medical uses of radiations. Half of this value, or 5 rem over a 30-yr period, was later allocated to all sources of radiation other than medical. This value of 5 rem during a 30-yr period yields a value of 0.17 rem/yr recommended as the average maximum exposure dose for man. This value is approximately equal to the amount of natural background radiation to which human beings are exposed in the USA. It is pointed out that the amount of natural background radiation varies considerably over the face of the earth and very large human populations have existed from earliest known times in the presence of levels of background radiation 10, 20, or more times that experienced in the USA and that no detrimental effects have been observed. Recommendations of the Federal Radiation Council (FRC) (1960) set an upper radiation dose limit of 0.5 rem per year for exposure to the individual, which is more restrictive than the 0.17 rem average dose per year. A principal AEC guide for radiation exposure from nuclear power reactors is based on the FRC (now incorporated into the Environmental Protection Agency) value of 0.5 rem per year exposure to an individual at the boundary of a reactor site. Because of the rapid dispersion of material coming from the reactor stack and because of the decay of radioisotopes present in the effluent this dose decreases rapidly with distance from the reactor site so the individual 50 miles from the reactor site would receive a dose of about 0.0005 rem per year, and the average dose to the entire U. S. population would be far below this figure. Data on the estimated average radiation exposure of the U. S. population during 1970 show that the principal source of exposure came from diagnostic medical x rays (50 to 150 millirem per year) and exposure from all other sources (including fallout from nuclear weapons testing, color TV sets, jet travel, and radioactive luminous paints) was very low, with the operation of 15 nuclear power plants contributing approximately 0.001 millirem (or 0.000001 rem) per year. (C.H.)

50860 (TID-25857, pp 104-30) ADEQUACY OF PRESENT RADIATION STANDARDS. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.). 1972.

In Environmental and ecological forum, 1970–1971.

The development of radiation protection standards in the USA is reviewed and the adequacy of present standards is evaluated. Data available on the biological effects on man following whole-body exposure to various doses and dose rates of γ and x radiation and of chronic internal irradiation following the uptake of radioisotopes are summarized. Extrapolated data indicate that the dose from natural background radiation may reduce the average life span of man by about 10 days. Data on the present average radiation dose per year to man from man-made sources of radiation are compared with values established for the maximum permissible radiation dose for the whole-body and various organs of man. The pathological consequences of diagnostic x ray exposure presently received by the US population are compared with the consequences of a hypothetical exposure of 0.85 mrem/yr from all nuclear industries. The consequences of an extremely rare hypothetical accident involving a nuclear power reactor for the human population are postulated. (C.H.)

50861 (TID–25857, pp 168–86) WHAT WE DO KNOW ABOUT LOW-LEVEL RADIATION. Taylor, Lauriston S. (National Council on Radiation Protection and Measurements, Washington, D. C.). 1972.

In Environmental and ecological forum, 1970–1971.

The criteria of the National Council of Radiation Protection and measurements (NCRP) used for setting radiation protection standards in the USA are reviewed. It is pointed out that dose-effect relationships for man in the dose range of 100 rems upward delivered at high dose rates can be regarded as well established on the basis of clinical and experimental data. However, while a tremendous effort has been made to discover significant deleterious effects of very low dose level and dose rate radiation on man, all results have been convincingly negative. The range considered covers an acute exposure to 1 or 2, or even a few more, rads received all at once and not frequently repeated; larger doses of 10 to 20 rads received all at once and rarely repeated; and chronic exposure to levels of millirads or less per day over long periods of time and totaling some 5 or 10 rads distributed over a lifetime. In spite of the lack of observable effects from low-level radiation doses, the NCRP has maintained the basic philosophy that there could be deleterious effects in the low dose range proportional to those observed at vastly higher doses. The upper limit of 170 mrem/yr average recommended for the human population for exposure from all man-made radiations, other than medical applications, is some hundred times lower than the lowest dose that has been shown to cause a statistically significant pathological change in man. This population dose limit is at least some hundred times higher than the average dose to the population estimated for the operation of all the nuclear power plants expected to be built up to the year 2000, assuming no improvements in production technology. It is emphasized that ionizing radiation, including its effects on man and the environment, is probably the most widely studied, best understood, and most widely used agent found essential to human health and well being. While it is true that radiation cannot be felt, seen, or tasted it can be detected and measured instantly at levels well below those levels of natural background radiation to which mankind has been exposed throughout his existence. (C.H.)

50862 RADIATION EXPOSURE OF CIVILIAN POPULATION DUE TO X-RAY EXAMINATIONS. Erdelyi, Mihaly (Orvostovabbkepzo Intezet, Budapest); Vittay, Pal. Orv. Hetil.; 3: No. 17, 968–70(1971). (In Hungarian).

Radiation exposure of medical origin on the civilian population is discussed in connection with its genetical aspects. The most frequent errors are showed, which are divided into two groups. The following problems are indicated as the origin of the technical failures: architecturally insufficient or technically incomplete radiography facilities and defective organization. X-ray examinations are classed in the second group, which are carried out because of wrong indication or with wrong methods, the possible reasons of which are the following: the common aspect of the medical work, the defensive curing, x-ray examinations due to administrative regulations or after the patients indication, unnecessary repetitions, and the ignorance of the clinicists of the x-ray examination indications. A proposal of 12 points is expounded for the reduction of the medicinal radiation exposure, the main paragraphs of which are: extended education on the indications of the x-ray examinations, elaboration of control regulations, the formation of hospital-clinical radiography facilities, establishment of an x-ray license for the operating personnel, radiography should be carried out only ten days following the menses to avoid intrauterine teratogen damages, elaboration of radiation safety house rules, a survey on the radiation exposure of the civil population, personal dosimetry of the patients, and creation of personal x-ray control cards. (INIS)

50863 CHROMOSOME ABERRATIONS AS BIOLOGICAL DOSIMETERS. Fritz-Niggli, H. (Univ., Zurich). Strahlenschutz Forsch. Prax.; 11: 36–47(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

An explanation is given of the general effect of ionizing radiation on chromosomes in germ and somatic cells. The classification of cells with regard to their radiation damage is set out. For quantitative studies, especially ring chromosomes and dicentric chromosomes are used, i.e., mutations not occurring normally. The results of chromosome investigations on survivors of radiation accidents, in Hiroshima and Nagasaki, and on therapeutically irradiated patients indicate a varying stability of the several aberrations. Attempts to use the in vitro gained dose relation curves for the calculation of radiation exposure of humans have failed. There also remains the question of the threshold dose, which probably values about 10 rem. A threshold dose is found for chronic irradiation with low doses, but no clear dose relation. Complications as to the estimation of radioinduced chromosome aberrations are brought about by existing non-radioinduced mutations. (INIS)

50864 CELL-KINETIC BASES OF RADIATION SYNDROMES AFTER WHOLE-BODY IRRADIATION. PATHOLOGY OF RADIATION DAMAGE. Cottier, H.; Buerki, H.; Graepel, P.; Laissue, J. (Univ., Bern). Strahlenschutz Forsch. Prax.; 11: 47–54(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Contrary to in vitro experiments with single cells concerning radiation damage and repair, it is difficult to judge the pathogenesis of radiation damage after whole-body irradiation. For the evaluation of short-term consequences causing danger to life, the damage of the blood-forming tissue and the gastrointestinal tract (GIT) plays an important part. The course of bone marrow and GIT syndrome is described and the critical phases are pointed out. For the regeneration, the so-called stem cells are of great importance. An attempt is made to draw conclusions for men from animal experiments. (INIS)

50865 CARE OF PATIENTS INVOLVED IN RADIATION ACCIDENTS: RECENT ADVANCES. Saenger, E. L. (Univ. of Cincinnati). Strahlenschutz Forsch. Prax.; 11: 54–78(1971).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

The purpose of this paper is to enable the physician to prepare and have ready an adequate medical program for the care of employees, visitors, and the general public who might be exposed to or injured by radiation in a given installation under any possible circumstance. The recommendations described here are applicable to civilian and military situations, for high and low radiation levels, for short- and long-term external and internal irradiations starting from incorporated nuclides. (INIS)

50866 COMBINED RADIATION DAMAGES. Messerschmidt, O. (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 11: 78–90(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Combined damages as the result of a combination of whole-body irradiation and other traumas occurred in humans for the first time after the atomic explosions in Japan. The findings gained in this case are described. An intensive research on combined damages in animal experiments started not before 1955. Especially in the Soviet Union, many experiments are carried out in this field. The results of these investigations are given, showing the special influence of time. (INIS)

50867 PRESENT STATUS OF RESEARCH ON BIOLOGICAL AND CHEMICAL RADIATION PROTECTION. Langendorff, H. (Heiligenberg-Institut, Baden, Ger.). Strahlenschutz Forsch. Prax.; 11: 90–6(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Starting from the first known radioprotectant cysteine, many similar substances were tested. Later on, compounds of different chemical structure with comparable efficiency were found. The dose reduction factor lies between 1.2 and 1.9. The combination of two radioprotective compounds makes it possible to increase the efficiency and the effective time. Some estrogens, TACE, and bacterial lipopolysaccharides are showing a longer time of efficiency and their radioprotective effect is warranted already at minimal doses. As to the dependence of effect on the amount given, there are two groups of compounds to be distinguished, one of them soon reaching a level of saturation. The efficiency of repeated application is not guaranteed, because of their toxicity. The protective effect is very good in the case of partial body irradiation. No special protection is given in the case of irradiation with neutrons or α particles. Various theories exist with regard to the protection mechanism, but up to date, the problem has not been solved. (INIS)

50868 MEDICAL PROVISIONS IN CASE OF A NUCLEAR DISASTER. Messerschmidt, O. (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 11: 100-9(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Survey of the problems arising from the absence of a concept for the elaboration of the fundamentals concerning the diagnosis and therapy of radiation and combination injuries in case of a large number of wounded people, and thus of the status of civil defense in the Federal Republic of Germany. (INIS)

50869 RADIATION ACCIDENTS IN NORDRHEIN-WESTFALEN DURING THE YEARS 1953 TO 1969. Rahm, G. Strahlenschutz Forsch. Prax.; 11: 109-24(1971). (In German).

From eleventh meeting of the German Medical Radiologists Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

Two basic requirements must be fulfilled for radiation injury: a radiation effect must have occurred; and the consequences of the damage must be defined according to location of irradiation, amount, symptom, and time after radiation exposure. For the acceptance as occupational disease, two further conditions have to be fulfilled: the irradiation must be related to the work done on the job; and the conditions set up by insurance contracts must be fulfilled. Types of radiation injuries are: whole-body irradiation; partial body irradiation; acute and chronic skin injuries; blood picture changes; other radiation injuries; and special incidents. The author gives the anamnesis of the 50 hitherto occurred cases of radiation injuries and compiles in various tables the mean rate of occurrence of the injuries according to type of injury, sex, profession, business, radiation source (x-rays, nuclides), dose, exposure time, cancer, acceptance of an occupational disease as such, exacerbations, and death (four cases). (INIS)

50870 RADIATION EFFECT AND TOLERANCE, NORMAL TISSUE. BASIC CONCEPTS IN RADIATION PATHOLOGY. Proceedings of the Sixth Annual San Francisco Cancer Symposium, October 16–17, 1970. Vaeth, Jerome M. (ed.). Frontiers of Radiation Therapy and Oncology, Volume 6. Baltimore; University Park Press (1972). 532p. $29.50. (CONF-701071).

Separate abstracts were prepared on 28 papers that discuss the relation of the radiation tolerance of surrounding normal tissues to optimum radiation dose selection for therapy of human neoplasms. (C.H.)

For abstracts of individual papers see: 50871–50890 and 50930–50937.

50871 DIRECTION FOR CLINICAL RADIATION PATHOLOGY. THE TOLERANCE DOSE. Rubin, P.; Casarett, G. (Univ. of Rochester, N. Y.). Front. Radiat. Ther. Oncol.; 6: 1-16(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The tolerance of the surrounding normal tissues to the effects of ionizing radiation is the limiting factor in determining the dose that can be delivered to a neoplasm over a period of time. Complications presented by variations in the radiosensitivity and time required for the biological repair of injuries of normal cells, tissues, organs, and systems in vivo in determining the tumoricidal dose and dose regime that will result in a minimum of pathological changes in the surrounding tissues are discussed. The need for an index to express normal tissue tolerance during radiotherapy is emphasized. Data are tabulated from an attempt to estimate injurious doses for various normal tissues on the basis of clinical observations and analysis of time-dose data. Hypothetical dose responses are presented for so-called radiosensitive neoplasms and dose-limiting tissues under two circumstances: one that assumes over 50% cancer control with a maximum of 5% complications during a five year period; and the second that assumes 50% cancer control while accepting a 50% risk of complications during a five year period. The irradiation schedule assumed supervoltage therapy (1 to 6 MeV); fractionation of 1,000 rads/week, with 5 daily fractions followed by a 2-day rest; and the treatment completed in 2 to 8 weeks, depending on the total dose. Volume modifications are also included. In favorable circumstances the radiation therapist would be willing to exceed the risk of minimum complications, while in unfavorable circumstances he would be unwilling to exceed the maximum risk, since the dose-response curve probably rises rapidly. (C.H.)

50872 ORGANIZED TISSUE ALTERATION. White, D. C. (Armed Forces Inst. of Pathology, Washington, D. C.). Front. Radiat. Ther. Oncol.; 6: 79-92(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The irradiation of organized tissues brings about a sequence of pathological changes involving the two histologically and functionally distinct divisions. Whereas the composition of the supportive compartment is for practical purposes common to almost all organized tissues, the components of the principal cell compartment will range from the essentially unresponsive, nonproliferative cells to the highly radiation sensitive rapid cell renewal systems. The effects produced in both of these compartments by the irradiation develop over a period of time which is largely regulated by the types of cells and the nature of the radiations. The parallel evolution of damage in the principal parenchymal cells and in the supportive cells, substances, matrices and fibers is characterized by extreme variation in the first compartment and by a relative uniformity of response in the latter. The complexity of the response is further compounded by variations in the amounts of irreversible or irreparable changes and the inherent propensities of the cells and tissues to compensate for and recover from the radiation injuries. The pathology in certain of the more radiation responsive tissues is distinctly biphasic with the principal cell compartment exhibiting characteristic early and often dramatic degenerative and regenerative effects. This is succeeded by a variable latent period and subsequent late or delayed alterations reflecting radiation-related compromise of effectiveness of the supportive elements, specifically the vessels. The extended response times in the principal cell compartments of most tissues, however, do not allow for practical resolution into early and late phases of radiation injury with the overt manifestations of radiation damage being largely the product of the progressive alterations in the supportive elements. From the foregoing summation covering a variety of radiation and biological factors, it becomes possible to identify the relative condition of an affected organized tissue at any given time after irradiation by assessing: the amount of residual, initial, direct injury to the principal cells and the supportive cells and substances; the extent of repair of the initial direct injury; the recuperative capacity of the stem cell compartment; the progression of secondary or indirect changes; and the intervention of extraneous stresses which may amplify damage and retard repair. (auth)

50873 APPLICATION OF A RET-DOSE SLIDE RULE RELATING DOSE, TIME, AREA-VOLUME, QUALITY, AND ANATOMIC FACTORS. Eads, D. L. (Mount Zion Hospital and Medical Center, San Franciso). Front. Radiat. Ther. Oncol.; 6: 108-42(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A mathematical model was developed for use in estimating the optimum radiation dose for therapy of neoplasms that would induce the minimum of injury to surrounding normal tissues. The model relates the ret dose to time, area volume, radiation quality, and anatomical factors. The model permits the reduction of the variables to a common denominator for use in comparisons of therapeutic results. (C.H.)

50874 CLINICAL RADIATION TOLERANCE OF THE SKIN AND UPPER AERODIGESTIVE TRACT. von Essen, C. F. (Univ. of California, San Diego, La Jolla). Front. Radiat. Ther. Oncol.; 6: 148-59(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

In the consideration of permissible tolerated radiation doses to the skin and upper alimentary tract during therapy of neoplasms in man, late connective tissue damage is the most significant injury; the time-dose-area isoeffect curves for acute epithelial injury and for chronic connective tissue injury are very likely dissimilar. A general equation for maximal permissible dosage is presented. (auth)

50875 RADIATION TOLERANCE OF THE GASTROINTESTINAL TRACT. Roswit, B.; Malsky, S. J.; Reid, C. B. (Veterans Administration Hospital, Bronx, N. Y.). Front. Radiat. Ther. Oncol.; 6: 161-81(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The tolerance of the gastrointestinal viscera is the principal limiting factor in the control of abdomino-pelvic cancer by high energy ionizing radiations. Damage to the esophagus, stomach, bowel, and rectum can be a disaster for the injured patient, giving rise to long-term distress, disability, and even death. It is essential, therefore, that the cardinal signs and symptoms of such injuries, early and late, be clearly understood and the factors which contribute to high risk be respected in the planning and delivery of treatment. In the light of previous experience with these complications, guidelines are suggested for limiting the risk. Every advance in modern technology should be exploited to maximum advantage. The margin for error is small. The penalty for faulty judgment or technique may be great. (auth)

50876 HEPATIC EFFECTS OF IRRADIATION. Kraut, J. W.; Bagshaw, M. A.; Glatstein, E. (Stanford Univ., Calif.). Front. Radiat. Ther. Oncol.; 6: 182-95(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The liver is not as radioresistant an organ as was once thought, but one that undergoes morphologic and functional change in a dose and time related manner. Excessive external irradiation results in an early potentially catastrophic vascular injury of a veno-occlusive type similar to that seen in the Budd–Chiari syndrome. Modification of this sequela is possible when delivering tumoricidal doses for, at least Hodgkin's disease, through combined external and ^{198}Au interstitial irradiation, wherein the differential between tumoricidal and morbid or lethal effects on the liver can be accomplished by the selective irradiation of the peripheral portions of the liver lobule. The potential hazard of early hematopoietic depression, however, requires that discrimination in patient selection and monitoring be carried out and for the present, limits such combined therapy to stage IV cases. It is hoped that animal studies now in progress, as well as continuing clinical observations, will lead to further beneficial refinements in this therapeutic approach. (auth)

50877 EFFECTS OF RADIATIONS ON KIDNEY, BLADDER, AND PROSTATE. Maier, J. G. (Walter Reed General Hospital, Washington, D. C.). Front. Radiat. Ther. Oncol.; 6: 198-227 (1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The clinical features, pathology, and treatment of the effects of radiation on the kidney, bladder, and prostate are reviewed. A more comprehensive understanding of radiation tolerance of these organs is helpful clinically in preventing such complications. Early recognition of the occurrence of such complications and proper therapy may help prevent their progression to a more severe injury or even death. (auth)

50878 RADIATION PATHOLOGY AND THE CLINICAL RESPONSE OF LUNG AND ESOPHAGUS. Phillips, Th. L.; Margolis, L. (Univ. of California, San Francisco). Front. Radiat. Ther. Oncol.; 6: 254-73(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Extensive clinical and experimental studies of radiation pneumonitis in mice are reported. The development of radiation pneumonitis is seen to be chiefly a capillary phenomenon at clinical dose levels (1,000 to 3,000 rads in a single dose). The time sequence of development, the steepness of the dose response curve for γ and x radiation and the recovery slope are similar in mice and in patients. Using the pulmonary $LD_{50/160}$ end-point in the mouse and clinical radiation pneumonitis in patients, the effect of fractionation was measured. Significant recovery between doses with a slope on log-log coordinates of 0.43 and a D_2-D_1 of 350 rads was found. The dose to cause 5% clinical pneumonitis in patients was 900 rets (about 2,650 rads in 20 fractions) and 1,040 rets (about 3,050 rads in 20 fractions) for 50% incidence. The $LD_{50/160}$ for mouse death in 10 fractions was 3,690 rads. Reaction of the esophagus was observed in mice irradiated to the whole thorax and in patients subjected to esophagectomy after irradiation. The damage appears between one and two weeks, and death occurs in mice between 10 and 20 days after a single dose. The $LD_{50/20}$ days in mice was 2,500 rads. The dose for a 5% incidence of clinical late esophageal damage is estimated as 1,850 rets (6,300 rads in 30 fractions) and for a 50% incidence 2,000 rets (6,650 rads in 30 fractions). (auth)

50879 RADIATION-INDUCED HEART DISEASE. Stewart, J. R.; Fajardo, L. F. (Stanford Univ., Palo Alto, Calif. Veterans Administration Hospital, Palo Alto, Calif.). Front. Radiat. Ther. Oncol.; 6: 274-88(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Injury to the heart following thoracic irradiation is most often manifested as pericarditis with fibrosis. Clinical features suggest that in the majority of instances, pericarditis is due to radiation injury of that organ rather than a tumor mediated reaction. Experiments in an animal model confirm this viewpoint. With fractionated irradiation, up to 1,500 rets to large volumes of the heart and up to 1,850 rets to small volumes are well tolerated. Retreatment of the mediastinum in Hodgkin's disease when a large volume of the heart receives at least 6,000 rads total dose carries a high risk of pericarditis and the more serious pancarditis. Radiation-induced pericarditis is often self-limited or easily treated and clinicians are cautioned to be aware of this entity and the potential need for life-saving pericardiocentesis or pericardiectomy. (auth)

50880 RADIATION EFFECT ON GROWING BONE AND CARTILAGE. Tefft, M. (Childrens Hospital Medical Center, Boston). Front. Radiat. Ther. Oncol.; 6: 289-311(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The dose used for irradiation and age at the time of such exposure to a growing epiphyseal center are factors in the production of bone growth retardation by irradiation. However, as in the spine, other factors, such as soft tissue atrophy and/or vascular embarrassment, undoubtedly play a significant role. Guidelines are presented to minimize these changes induced by therapy and to predict the results of this relationship. (auth)

50881 TOLERANCE OF MATURE BONE AND CARTILAGE IN CLINICAL RADIATION THERAPY. Parker, R. G. (Univ. of Washington, Seattle). Front. Radiat. Ther. Oncol.; 6: 312-31(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review of studies on radiation effects on bone and cartilage showed that the radiation tolerance of mature bone and cartilage is a factor in the formulation of radiotherapeutic dose regimes. Changes in the environment of irradiated tissues influence their radiation tolerance as do other factors of total radiation dose, dose increment size, radiation quality, pattern of application, use of radiation adjuvants, irradiated tissue volume, tissue condition, tumor site, and capacity for regeneration and repair. Mature cartilage, when intact and healthy, will tolerate radiation doses necessary to control adjacent epidermoid carcinomas. The development of malignant tumors in mature bone following ionizing radiation is associated with massive total doses with tissue damage, frequently repeated applications, and a long latent period. (H.L.W.)

50882 RADIATION EFFECT AND TOLERANCE OF THE CENTRAL NERVOUS SYSTEM. Kramer, S.; Southard, Martha E.; Mansfield, C. M. (Thomas Jefferson Univ. Hospital, Philadelphia). Front. Radiat. Ther. Oncol.; 6: 332-45(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Based on a review of the literature and clinical experience, it is concluded that the tolerance of the brain is equivalent to the tolerance of skin and soft tissue. The functional tolerance of the spinal cord to irradiation is probably some 10 to 15% lower. The concept of functional tolerance is stressed as an important one. In the ultimate analysis, the clinician must make a value judgement as to what level of risk he is willing to accept in any particular clinical situation within the constraints set by our past experience. (auth)

50883 EFFECTS OF IONIZING RADIATIONS ON THE EYE. Merriam, G. R. Jr.; Szechter, A.; Focht, Elizabeth F. (Columbia-Presbyterian Medical Center, New York. Columbia Univ., New York). Front. Radiat. Ther. Oncol.; 6: 346-85(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

An attempt was made to correlate the known clinical and experimental data on the effects of radiation on the various ocular structures. It is hoped that this information will prove of value to therapists in planning treatment schedules. In addition, consideration should be given to the quality of radiations and proper depth-dose distribution when treating various lesions of the eye using ^{90}Sr or radium applicators or grenz rays for superficial lesions, and betatron x radiations for retinoblastoma. The existing clinical and experimental data on the radiation effects on the eye are, by and large, far too incomplete to establish even approximate time-dose relationships. Additionally, much of the clinical data appeared without specification of treatment schedules; in many cases, only total doses are given, sometimes the overall time of therapy, and seldom the mode of fractionation. Recent investigations have shown that the number of fractions and dose/treatment are decisive in fractionation effect, while the overall time is less significant. Only when a daily schedule of treatments is used, may the data be plotted as dependent upon one parameter, either number of fractions or time expressed in days. Complete sets of data are necessary for each radiation quality, and relating to a well-established level of biological effect in the population under study. At the present time, only the effect of radiations on the lens may be analyzed in this way. The rate of mitosis varies significantly in ocular tissues, also the level of metabolism, which is rather high in the cornea and low in the lens. Although prediction of given doses producing a particular effect is rather risky, one may try to approximate the time-dose dependence from existing data and attempt to correlate this with some other rather well-investigated effects (skin erythema and moist desquamation). It seems that, excluding the lens, neural retina, choroid and optic nerve, the remaining tissues are, from the point of radiosensitivity, similar to the skin. The available data for corneal ulceration were plotted as a Strandqvist type curve (log dose vs. log time), assuming regular fractions where this information was not given. A slope of 0.33 was found which is similar to that for moist desquamation of the skin. Much more data is needed to substantiate this, but from clinical experience it seems reasonable as a working hypothesis. (auth)

50884 EFFECTS OF IRRADIATION OF THE ENDOCRINE GLANDS. **Einhorn, J.; Einhorn, N. (Radiumhemmet, Stockholm). Front. Radiat. Ther. Oncol.; 6: 386-400(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A literature review is presented on the effects of radiation on the pituitary gland, adrenals, thyroid, and parathyroid glands. Factors considered in estimating the radiosensitivity of the gland are the function, morphological changes, and reproductive integrity of the cells. Discussions are given of the effects of time elapsing after irradiation, dose levels in animals and man, clinical implications, and sources of error. (H.L.W.)

50885 RADIATION MYELITIS OF THE SPINAL CORD. **Maier, J. G. (Walter Reed General Hospital, Washington, D. C.). Front. Radiat. Ther. Oncol.; 6: 404-11(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Radiation myelitis of the thoracolumbar spinal cord has developed in 15 patients receiving irradiation for testicular cancer and in 3 patients following mantle field irradiation for Hodgkin's disease. The time-dose relationship in such cases has been considered and the relative risk of development of such sequelae discussed. To prevent such complications the treatment planning must include consideration of the length or volume of spinal cord irradiated, the dose per fraction, the number of fractions, the interval between fractions, the total dose and overall time. The nominal standard dose (NSD) concept appears useful in correlating several of the factors and planning appropriate therapy. An NSD of 1,300 ret (rad equivalent therapy) is recommended as a tolerance level for large volume irradiation to the thoracolumbar spinal cord utilizing ^{60}Co irradiation or its equivalent. (auth)

50886 RADIATION TOLERANCE OF LYMPHOID TISSUE. **Dettman, P. M.; Demis, A. J.; Storaasli, J. P. (Univ. Hospitals and Veterans Administration Hospital, Cleveland). Front. Radiat. Ther. Oncol.; 6: 428-44(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review is presented of the effects of radiation on the transport function, the barrier function, and immune properties of lymphoid tissue. The transport function of lymphatic vessels is relatively resistant to therapeutic radiation doses. Lymphatic obstruction with edema following a treatment course occurs most commonly in situations complicated by another tissue insult such as surgical manipulation. Furthermore, this obstruction is more likely secondary to a fibrosis rather than direct vessel injury. The so-called barrier function of lymph nodes is also relatively radiation resistant. However, if the barrier function is significant in cancer defense, the partial failure of the barrier noted experimentally following localized therapeutic radiation doses may be significant. Evidence is circumstantial that localized radiation treatment of normal lymphoid tissue interferes with host resistance to cancer and further investigation is indicated to determine if this may be an important tolerance consideration. (auth)

50887 RADIATION CARCINOGENESIS. **Upton, A. C. (State Univ. of New York, Stony Brook). Front. Radiat. Ther. Oncol.; 6: 470-8(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

An association between irradiation and neoplasia has been detected in human populations at lower levels of radiation exposure and involving a greater diversity of neoplasms than hitherto suspected. Nevertheless, the relation between incidence and dose cannot be specified precisely for any neoplasm. Moreover, the available data indicate that the dose-incidence relation may vary, depending on the type of neoplasm in question, the age of the population at the time of exposure, and other variables. In experimental animals, such variables include constitutional (species, sex, physiological state), environmental (viruses, chemicals, dietary constituents), and radiological (distribution of the dose in time and space) factors, the interaction of which is so complex as to defy characterization at present. Furthermore, although the mechanism of the neoplastic transformation has yet to be defined fully for any case, a succession of changes seems generally to be required, the evolution of which may be influenced by radiation effects elsewhere in the body as well as in the tumor-forming cells themselves. Ionizing radiation can thus be envisaged to exert carcinogenic effects through a variety of mechanisms, the dose-effect relationship varying accordingly, depending on the circumstances in question. (auth)

50888 EFFECTS OF IONIZING RADIATIONS ON AGING AND LIFE SHORTENING IN HUMAN POPULATIONS. **Conard, R. A. (Brookhaven National Lab., Upton, N. Y.). Front. Radiat. Ther. Oncol.; 6: 486-98(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Malignant transformation is usually viewed as a process of aging since the incidence increases with aging. The development of such malignancies is one of the best correlated late effects of exposure in both animals and human beings and is responsible largely for the life shortening observed. Such malignancies have been noted following whole body, partial body, or specific organ exposure due to selective absorption of radioactive isotopes. Following whole body (sublethal) exposures, leukemia is definitely established as a late effect and it appears that thyroid cancer as noted in the exposed Japanese can be added to the list. Since malignancies other than leukemia were increased in radiologists (a study covering a relatively long period of time) other types of radiation-induced malignancies may yet appear in the exposed Japanese and Marshallese populations. Heretofore, radioiodine had not been thought to play an important role in malignant transformation. However, the recent development of the high incidence of both benign and malignant nodules in the Marshallese clearly indicates the importance of radioiodine exposure in this regard. The high incidence of thyroid abnormalities in the Marshallese children along with the related retardation of growth emphasizes the caution that must be observed in the use of radioiodine. Many of the nonspecific effects of irradiation bear similarities to ordinary aging changes. Since the underlying changes of ordinary aging are not clearly defined, it is understandable that such radiation-induced changes are even less understood. There are no pathognomonic radiation changes characterizing late effects. Measurement of the usually-recognized aging changes in the exposed Japanese and Marshallese populations have failed to reveal such effects of irradiation. However, late effects other than neoplasia have been found in irradiated human populations such as life shortening in radiologists, development of lens opacities, persistence of chromosome aberrations and certain immunohematological changes. Most of these effects such as cataracts, skin changes, chromosome aberrations, etc., do not appear to be related to lethality, though collagenous and fibrotic changes in connective tissue and blood vessels may indirectly have a causal relationship to mortality. The individual genetic predisposition to such alterations is an important area about which we know little. Also complicating environmental factors (socio-economic-geographic, stress of trauma, heat, cold, disease epidemics, etc.) no doubt play an important role in the development of late radiation effects. (auth)

50889 CHOICE AND MEANING OF TOLERANCE IN RADIOTHERAPEUTICS. THE BAYESIAN MODEL. **Rubin, P. Front. Radiat. Ther. Oncol.; 6: 499-511(1972).**

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The need to develop a value system beyond that of uncomplicated cures of neoplasms by radiation so that costs can be assigned to the other outcomes of therapy is an important area for the individual radiotherapist and groups of radiotherapists to explore. It is the key to understanding the logic of radiotherapeutic decision-making. The need for knowing more precisely the survival rates in certain target groups and the tolerance dose, defined as $TD_{5/5}$ or $TD_{50/5}$, is another important factor. A model for therapeutic decision-making, based on the relation of the optimal tumor dose and the tolerance doses of surrounding normal tissues, is discussed. The value of the model lies in the ability of the radiotherapist to assign values to the various parameters. The major questions posed are: How close to the optimum is the therapist operation, and what are his options for improvement? Application of this model to specific cancers should reveal something about the underlying philosophy of the therapist and deserves careful assessment. The final decision, however, rests with each radiotherapist and his value system regarding the expected desirability of a specific outcome in his search for optimization of treatment. (C.H.)

50890 RADIOTHERAPY AND TOLERANCE. Mendelsohn, M. L. (Univ. of Pennsylvania, Philadelphia). Front. Radiat. Ther. Oncol.; 6: 512-23(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

The optimization of radiotherapy involves maximizing the probability of destroying the cancer while minimizing the probability of injuring surrounding normal tissues. It is pointed out that factors that must be considered include: the condition of the patient; the natural history of the disease; the radiobiological responses of the neoplastic and normal tissues; the physical characteristics of the ionizing radiation; the treatment plan; and other pertinent factors. A biological model for therapeutic decision making, based on the optimal tumor dose and the tolerance doses of surrounding normal tissues, is described. (C.H.)

50891 IN SITU REPAIR BY HUMAN MALIGNANT CELLS OF RADIATION-INDUCED DNA BREAKS. Dalrymple, Glenn V.; Riggs, Orval E.; Boyd, Charles M.; (and others) (Univ. of Arkansas, Little Rock. Little Rock Veterans Administration Hospital, Ark.). Radiology; 104: No. 2, 415-18(Aug 1972).

The rejoining of radiation-induced DNA breaks, characterized by 5′ termini, was measured by the polynucleotide kinase method. This method has potential clinical value because DNA damage can be measured for cells within solid tissue. Following irradiation of a human squamous-cell carcinoma, DNA rejoining occurred, but at a slower rate than observed for mammalian cells in culture. The results of the study indicate that cells within solid tumors, in situ, are able to repair at least some radiation-induced DNA damage. The importance of this type of repair to tumor response following therapeutic radiology is not known at present. (auth)

50892 PARADOXICAL SPLENIC ENLARGEMENT FOLLOWING RADIATION THERAPY. Samuels, L. D. (Children's Hospital, Columbus, Ohio. Ohio State Univ., Columbus). Radiology; 104: No. 2, 389-91(Aug 1972).

Serial ^{99m}Tc-sulfur colloid liver and spleen scans of 10 children whose spleens were previously normal in size revealed enlargement of the spleen following megavoltage γ radiotherapy for Wilms's tumor or adrenal neuroblastoma. Splenomegaly tended to persist in children whose liver configuration was altered by radiotherapy. Clinical evidence of hypersplenism was not consistent, but transient thrombocytopenia and neutropenia did not occur in some cases. Follow-up liver and spleen scans are recommended to prevent confusion of secondary splenomegaly with recurrent malignant disease. (auth)

50893 ORAL CARE OF PATIENTS IRRADIATED FOR CANCER OF HEAD AND NECK. Carl, William; Schaaf, Norman G.; Chen, Tah Yee (Roswell Park Memorial Inst., Buffalo, N. Y.). Cancer; 30: No. 2, 448-53(Aug 1972).

Close cooperation between physician, dentist, and patient is essential when considering oral care of patients irradiated for cancer of the head and neck. Frequent dental examination, topical fluoride application, and meticulous oral hygiene at home can prevent loss of the teeth. Xerostomia, following radiation therapy, seems to be the major factor in decay development. Silver amalgam is at present the most practical material in restoring the cervical dental lesions seen most often after irradiation. Dental prostheses require frequent checks to eliminate irradiation and pressure which may precipitate osteoradionecrosis. Extractions after radiation therapy can be performed with a reasonable degree of safety, if done with little trauma and under antibiotic coverage. A prophylactic approach to the problem of radiation decay and periodontal breakdown keeps oral complications within controllable limits. (auth)

50894 VAGINAL STENOSIS FOLLOWING IRRADIATION THERAPY FOR CARCINOMA OF THE CERVIX UTERI. Hartman, Patrick; Diddle, A. W. (Univ. of Tennessee, Knoxville). Cancer; 30: No. 2, 426-9(Aug 1972).

Eighty-eight per cent of 221 indigent women treated with irradiation for invasive carcinoma of cervix uteri acquired some degree of vaginal stenosis. This complication is caused by denudation of the vaginal epithelium and circumferential fibrosis of the perivaginal tissues. For a given patient, the maximum amount of obliteration occurred within one to eight months after completion of radiation treatment. The majority sustained maximum stenosis in three months or less. Patients failed to use preventive measures through psychosexual reasons or fear of spreading or aggravating the cancerous disease. To minimize or prevent the complication, measures to dilate the vagina and administration of estrogens to promote epithelization and increased vascularity of the tissues are recommended before radiation treatment is completed or shortly thereafter. (auth)

50895 RISKS AND BENEFITS OF IONIZING RADIATIONS IN MEDICINE. Cigna, Arrigo A. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 18: No. 5, 28-9(May 1972). (In Italian).

Sources of the radiation exposure of human populations and dose estimates for each source, including cosmic radiations and natural background radiation, are discussed. Data on the estimated dose received by the population of the USA from all sources during 1970 are tabulated. Data on the estimated genetic radiation dose per year received by the population of 14 countries during diagnostic radiography are tabulated. The genetic risk to the population from all diagnostic uses of radiations, including the use of radioisotopes as tracers for clinical studies, are reviewed in relation to the benefits to be derived. (C.H.)

50896 SOLAR FLARES AND THE CONCORDE. Brit. Med. J.; 4: No. 5780, 127-8(16 Oct 1971).

At the cruising height of the Concorde, (75,000 to 85,000 ft), atmospheric shielding is reduced to 36 and 29 g/cm^2 respectively. A passenger travelling in a supersonic aircraft and exposed to every major solar flare during a complete solar cycle would accumulate a radiation dose calculated to be 4.4 rem in 11 years, (the ICRP recommended maximum permissible dose is 0.5 rem per year). The dose is higher for pilots, who are also exposed to cosmic radiation. The following problems are briefly mentioned: prediction of flares, diving to a safe altitude, and partial shielding, including the possibility of using a layer of Micrococcus radiodurans as biological shielding, and deflection of radiation from the aircraft. (TSS) (UK)

50897 RADIATION PROTECTION ON BOARD OF A NUCLEAR SHIP. Tidow, R. Muenchen. Med. Wochenschr.; 112: No. 23, 1112-17(1970). (In German).

One year's medical experience in radiation protection on board the NS "Otto Hahn" is reported. During several trips under a wide range of climatic and sea conditions between 78°N. and the equator, the radiation levels in the controlled area were found to be so low that the dosimetry of persons potentially exposed to radiation as indicated by film plates and pencil dosemeters, did not show measurable values. Even at repair work at the yard, the dose remained within the lower third of the tolerance limits. The corresponding medical investigations did not reveal any morbid effects, which might have prevented assignments inside the controlled area. The possibilities and the limits of medical actions are closely related in view of the unalterable environmental conditions. The therapy depends on recommendations of experts in radiation protection, which are adapted to requirements on board. For nuclear ships without physicians, the care for the crews' health is the responsibility of the captain in compliance with his conventional assignments, but the authority of the radiation health engineer should be extended. (GF)

50898 CONCISE DENTAL RADIOGRAPHIC SURVEY DATA FORM. Tanner, R. L. (Univ. of Tennessee, Memphis). Health Phys.; 23: No. 3, 363-5(Sep 1972).

A one page data format with explanation is illustrated for use in facilitating the radiation safety survey of a dental x-ray installation. All the recommendations of the National Council of Radiation Protection (Report No. 35), are included among the thirty items on the form. A special feature is the ease with which the completed form may be inspected for compliance with these recommendations. (auth)

50899 TREATMENT OF RADIATION PROCTITIS. Jacobs, H. (Univ., Homburg, Ger.). Geburtsh. Frauenheilk.; 31: 1114-7 (Nov 1971). (In German).

Forty women with radiation proctitis were treated with systemic, local, or combined Salicylazosulfapyridine (Azulfidine). Following 6 weeks of treatment, 17 women were cured and 20 patients showed improvement of their symptoms. The findings were confirmed by sigmoidoscopy and barium enema. Especially the combined treatment with Azulfidine suppositories and tablets is therefore recommended in the treatment of radiation proctitis. (auth)

50900 SCOPE AND EVALUATION OF RESULTS SECONDARY TO HEMATOLOGICAL EXAMINATIONS MADE WITHIN THE FRAMEWORK OF PERIODICAL MEDICAL INSPECTIONS OF PERSONS EXPOSED TO THE EFFECT OF CHRONIC RADIATION. Guskova, A. K.; Sokolov, V. V.; Gribova, I. A. Gig. Tr. Prof. Zabol.; No. 8, 18-21(Aug 1972). (In Russian).

The organization of hematological examinations of persons handling sources of ionizing radiation is discussed. Proceeding from the existing dose rates, these persons are divided into three groups with differential approach to the scope and periodicity of the hematological examination. Different possibilities for scientific utilization of the information obtained secondary to examination of these groups are outlined. (auth)

Vertebrates

Refer also to abstracts 50673, 50796, 50797, and 50799.

50901 (AEC-tr-7316) RADIOBIOLOGY, VOL. 12, NO. 1, 1972. Translation of Radiobiologiya; 12: No. 1, 1-160(1972). 239p. Dep. NTIS.

Separate abstracts were prepared for the 27 papers in this cover-to-cover translation. (E.R.B.)

For abstracts of individual papers see: 50794—50798, 50814, 50815, 50819, 50820, 50830, 50831, 50902—50916, and 50980.

50902 (AEC-tr-7316, pp 24-33) CHANGE IN THE COMPLEX OF SUPERMOLECULAR DNA: RESIDUAL PROTEIN IN THE THYMUS AND LIVER OF γ-IRRADIATED RATS. Strazhevskaya, N. B.; Krivtsov, G. G.; Krasichkova, Z. I.; Struchkov, V. A. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 12: No. 1, 19-25(1972).

The amino acid composition of the residual proteins (RP) of the supermolecular DNA (SMDNA) of the rat thymus and liver, chicken erythrocytes, loach sperm, and T2 phase was studied. It was shown that the RP is a nonhistone acid protein; normally the amounts and compositions of the RP in the DNA from these objects differ. Immediately after γ irradiation of rats at a dose of 1 kR, a substantial (two-fold) increase in the firmly bound RP in the SMDNA of the thymus (a radiosensitive organ) and a less substantial increase (by 42%) in the liver (a radioresistant organ) were detected; no such effect was observed in irradiated T2 phase. The dynamics of the change in the qualitative and quantitative composition of the RP in SMDNA of the thymus and liver of irradiated rats differ and are correlated with the elastoviscosity of these DNA's. It was established that in the γ irradiation of animals, the primary radiation effect involves not only structural damages to DNA, but also the residual protein, which forms a nonspecific complex with it. The possible role of the RP in the organization and functioning of the SMDNA in the cell is discussed. (tr-auth)

50903 (AEC-tr-7316, pp 46-56) TRANSCRIPTION IN THE LIVERS OF IRRADIATED ANIMALS. Paskevich, I. F. (Scientific Research Inst. of Medical Radiology, Kharkov). Translated from Radiobiologiya; 12: No. 1, 33-9(1972).

Questions of the regulation of transcription in the livers of irradiated animals are discussed. The role of the histones, nonhistone proteins, and RNA in these processes is considered. It is suggested that the histones are nonspecific inhibitors of the template activity of DNA; more specific regulators of RNA synthesis are the nonhistone proteins, which form complexes with the histones or with definite portions of DNA, and certain fractions of RNA, which play the role of derepressors. (tr-auth)

50904 (AEC-tr-7316, pp 57-64) SURVIVAL OF ANIMALS AND CONCENTRATION OF DNA AND ITS METABOLITES IN THE SPLEENS OF IRRADIATED RATS AFTER A SINGLE INJECTION OF HOMOLOGOUS DNA. Mazurik, V. K.; Podgorodnichenko, V. K.; Bryksina, L. E. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 12: No. 1, 40-4(1972).

A single injection of high-polymer homologous DNA in a dose of 1.5 mg per 100 g of weight significantly increased the 30-day survival of irradiated rats, providing for a restoration of the DNA concentration in the spleen to the initial values by the 11th day after the radiation influence. The action of DNA is not associated with a supplementation of the mononucleotide pool on account of depolymerization of the preparation induced, and probably consists of an enhancement of the mechanisms responsible for the synthesis of intrinsic DNA's in the cells of the hematogenic tissue. (tr-auth)

50905 (AEC-tr-7316, pp 65-74) INVESTIGATION OF THE ACTIVITY OF CERTAIN ISOENZYMES OF THE MUCOSA OF THE SMALL INTESTINES OF RATS DURING ACUTE RADIATION SICKNESS. Sharetskii, A. N.; Surinov, B. P.; Kashkin, K. P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 12: No. 1, 45-51(1972).

The change in the activity of individual isoenzymes of the alkaline and acid phosphatases, aspartate aminotransferases, acetyl- and carboxylesterases in the mucosa of the small intestines of rats at various periods after γ irradiation of the region of the abdomen at a dose of 1000 rad was followed by electrophoresis in agar gel. An independent change in the activity of the individual isoenzymes and a substantial decrease in the activity of most of the enzymes by the time of death of the animals was demonstrated. The data obtained were compared with information on postradiation changes in the cell population of the mucosa of the small intestine. (tr-auth)

50906 (AEC-tr-7316, pp 91-9) BLOOD PLASMA PROTEINS OF THE TUNDRA VOLE MICROTUS OECONOMUS, LIVING UNDER CONDITIONS OF INCREASED NATURAL BACKGROUND RADIATION. Aliev, A. T.; Korzhuev, P. A.; Kashkin, K. P. (Inst. of Biology, Syktyvkar, USSR). Translated from Radiobiologiya; 12: No. 1, 63-8(1972).

Five fractions were isolated from the blood plasma of tundra voles by the method of paper electrophoresis: albumin, α_1-, α_2-, β-, and γ-globulins. The qualitative composition and electrophoretic mobility of the protein fractions in the normal state are identical for females and males. The quantitative ratio of the plasma protein fractions varies depending on the age and sex of the animal. In tundra voles living under conditions of an increased natural background radiation, there are changes in the composition of the blood, which are expressed in a decrease in the total protein, albumins, and γ-globulins and an increase in the α- and β-globulins. (tr-auth)

50907 (AEC-tr-7316, pp 100-11) MIGRATION OF STEM CELLS FROM SHIELDED BONE MARROW IN THE CASE OF NONUNIFORM IRRADIATION. Petrov, R. V.; Khaitov, R. M. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 12: No. 1, 69-76(1972).

The migration of stem cells from bone marrow shielded during irradiation was investigated by methods of exogenous and endogenous cloning of hemopoietic elements. It was established that the repopulation of the hematogenic and lymphoid organs in mice nonuniformly irradiated in lethal doses is associated with the discharge into the blood stream of hemopoietic stem cells, which recirculate and populate the irradiated tissues. It was shown that the intensity of the migration of stem cells from shielded bone marrow does not decrease for a long time after irradiation. The data obtained demonstrate the presence of an active exchange and recirculation of stem cells in the organism. (tr-auth)

50908 (AEC-tr-7316, pp 112-22) COMPARISON OF THE EFFECTS OF BRIEF AND PROLONGED IRRADIATIONS IN EQUAL NONLETHAL DOSES ON THE HEMATOGENESIS OF MICE. Chertkov, K. S.; Khramchenkova, S. P. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 12: No. 1, 77-84(1972).

Brief and prolonged irradiation of mice at a dose of 400 R does not cause death of the animals and does not lead to any significant differences in the kinetics of the depopulation and restoration of the cellular composition of the blood, thymus, spleen, and bone marrow. The basic difference in the effects of the irradiations compared is manifested in the fact that 24 and 48 hrs after a brief irradiation, a smaller number of colony-forming cells in the bone marrow is recorded. In addition, the number of colony-forming cells decreases somewhat in the period immediately following the end of the brief irradiation, and during the same period it increases appreciably in the case of a prolonged influence; the rate of this increase is constant and can be described by an exponential or step function. (tr-auth)

50909 (AEC-tr-7316, pp 143-9) HYPERCORTICISM AND ITS ROLE IN THE PATHOGENESIS OF ACUTE RADIATION SICKNESS. Moroz, B. B. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 12: No. 1, 98-102(1972).

It was established in experiments on various species of animals that the phenomena of hypercorticism in acute radiation sickness after γ irradiation depend on the increase in the highly active free fraction of glucocorticoids. The main factor in the pathogenesis of acute radiation sickness is the intensification of the glucocorticoid activity at the height of radiation sickness, which has an inhibiting influence on the course of recovery processes in radiosensitivity tissues. The prevention of phenomena of hypercorticism in rats by preliminary autotransplantation of the adrenals lightens the course of radiation sickness. (tr-auth)

50910 (AEC-tr-7316, pp 150-4) STIMULATING EFFECT OF INSULIN ON THE PROCESS OF BONE MARROW HEMATOGENESIS DURING ACUTE RADIATION SICKNESS. Barkalaya, A. I.; Krylova, T. G. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 12: No. 1, 103-7(1972).

Under the conditions of regulation of glycemia and corticism by insulin during acute radiation sickness, the restoration of bone marrow hematogenesis was studied in rats. It was found that in the case of normalization by insulin of the dynamics of glucose and corticosterone in the blood of irradiated animals, the restoration of all types of bone marrow hematogenesis is substantially improved. (tr-auth)

50911 (AEC-tr-7316, pp 155-9) COMPARISON OF THE CONTENT OF ADENYLIC NUCLEOTIDES AND THE ACTIVITY

OF THE PROCESS OF OXIDATIVE PHOSPHORYLATION IN THE RAT THYMUS AFTER TOTAL X IRRADIATION. Baisakhatov, R.; Khanson, K. P. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Translated from Radiobiologiya; 12: No. 1, 107-10(1972).

Total X irradiation of animals at a dose of 1000 rad leads to a decrease in the total content of nucleotides in the rat thymus 15 min and 1 hr after the influence, which is due to a loss of fractions of ADP and AMP. A decrease in the amount of ATP in the thymus occurs 4 hrs after irradiation. The ability of thymus homogenates to esterify inorganic phosphate is already reduced 15 min after irradiation; after 1 hr the effect increases, while after 4 hrs, together with a sharp decrease in the level of phosphorylation, the oxidative activity of the homogenate is also substantially suppressed. The latter effect coincides in time with the decrease in the ATP content in the thymus. (tr-auth)

50912 (AEC-tr-7316, pp 167-71) DYNAMICS OF THE CONTENT OF BIOGENIC MONOAMINES IN THE TISSUES OF GUINEA PIGS IN THE EARLY PERIODS AFTER TOTAL IRRADIATION. Kostyukovskaya, L. S. (Inst. for the Advanced Training of Physicians, Kharkov). Translated from Radiobiologiya; 12: No. 1, 114-17(1972).

In the early periods after irradiation of guinea pigs at doses of 472 and 1134 rad, the mobilization of catecholamines and serotonin was manifested only in certain tissues. A total absence of hyperserotoninemia and signs of leviation of serotonin and noradrenalin in the spleen and adrenalin in the adrenals were detected. This agrees with the hypothesis of the significance of mobilization of catecholamines and serotonin for radioresistance, since guinea pigs are the most radiosensitive species among the mammals. (tr-auth)

50913 (AEC-tr-7316, pp 184-8) CHANGE IN THE CONTENT OF CATECHOLAMINES IN THE HYPOTHALAMUS AND RETICULAR FORMATION OF THE BRAIN IN THE LONG-TERM PERIODS AFTER IRRADIATION. Prokudina, E. A.; Bazanova, N. V. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Translated from Radiobiologiya; 12: No. 1, 126-9(1972).

The content of catecholamines (noradrenalin and adrenalin) in the hypothalamus and reticular formation in rats was investigated 1, 3, 6, 9, and 12 months after irradiation at a dose of 460 R. A significant decrease in the level of catecholamines in the investigated structures of the brain was demonstrated one month and 6 to 12 months after the radiation influence. After three months, the content of noradrenalin in the hypothalamus and reticular formation was significantly elevated; the adrenalin concentration approached the norm. The data obtained are evidence of substantial changes in the functional state of the hypothalamus and reticular formation in the long-term periods after irradiation. (tr-auth)

50914 (AEC-tr-7316, pp 189-93) INFLUENCE OF THE INTRODUCTION OF LIPOPOLYSACCHARIDES ON THE LEVEL OF RESPIRATORY EXCHANGE AND THE SURVIVAL OF IRRADIATED MICE. Mishustova, Ya.; Novak, L.; Kautska, I. (Inst. of Biophysics, Brno). Translated from Radiobiologiya; 12: No. 1, 129-32(1972).

The influence of postradiation administration of lipopolysaccharides from the grape (LPS) on the respiratory exchange, body temperature, and survival of irradiated mice was investigated. Mice of the H line, males, were irradiated on a TUR apparatus with x rays at a dose of 700 R. Lipopolysaccharides were administered intraperitoneally three times in doses of 2.5 mg/kg of weight at intervals of 30 min, 24, and 72 hrs after irradiation. The administration of LPS 30 min after irradiation reduced the inhibiting effect of irradiation on the respiratory exchange, manifested 24 hrs after irradiation in the control group. Lipopolysaccharides negligibly increased the survival of the irradiated mice and the average lifetime of the animals that died. (tr-auth)

50915 (AEC-tr-7316, pp 194-200) INFLUENCE OF DESYMPATHIZATION ON THE STATE OF CELL PROLIFERATION IN THE THYMUS OF IRRADIATED MICE UNDER CONDITIONS OF PROTECTION WITH CYSTAPHOS. Zabalueva, I. I.; Ryabukha, A. K. (Central Scientific Research Inst. of Roentgenoradiology, Leningrad). Translated from Radiobiologiya; 12: No. 1, 132-6(1972).

The influence of sympatholitin in doses of 5 and 10 mg/kg on the state of the proliferative processes in the thymus of irradiated mice (500 R) was studied under conditions of protection with cystaphos. It was shown that intraperitoneal injection of sympatholitin 2 hrs before irradiation aggravates the injurious effect of radiation (one day after irradiation) and inhibits the development of recovery processes in the thymus (seven days after irradiation). This action of the preparation decreases with decreasing dose and increasing time of observation. Sympatholitin does not change the radioprotective effect of cystaphos with respect to cell proliferation of the thymus. (tr-auth)

50916 (AEC-tr-7316, pp 201-6) QUANTITATIVE EVALUATION (ACCORDING TO THE TOXIC EFFECT) OF THE ABSORPTION AND ELIMINATION OF CYSTAPHOS, S,β-AMINOETHYLISOTHIURONIUM, AND 5-METHOXYTRYPTAMINE AFTER INTRAPERITONEAL AND INTRAGASTRIC INJECTIONS. Davydov, B. I. Translated from Radiobiologiya; 12: No. 1, 136-40 (1972).

The regression equations of the elimination of cystaphos ($D_e = 10.65-2.86 \cdot \log T$) and AET ($D_e = 6.97-0.93 \cdot \log T$) were determined for the case of intraperitoneal injection. The curves of the assimilation of these protectors from the gastrointestinal tract and the curves of the accumulation of the parenteral dose in this mode of administration are cited. Mexamine, both in the case of intraperitoneal and in the case of intragastric injection, is eliminated at almost the same rate (biological half-life equal to 5 to 10 min). (tr-auth)

50917 (COO-2123-2) EFFECT OF PRENATAL IRRADIATION ON GROWTH OF IMMUNOLOGIC COMPETENCE. Technical Progress Report. Datta, Surinder P. (Wisconsin Univ., Kenosha. Div. of Science). 31 Jul 1972. Contract AT(11-1)-2123. 11p. Dep. NTIS.

The broad objective of the project is to determine the effects of prenatal x irradiation on the postnatal growth of lymphoreticular tissue, humoral antibody production, and cellular immunity. Up to the age of 12 weeks, the body weights of prenatally irradiated (150 R, 17.5 day of gestation) Balb/c males are consistently lower than those of control animals. The females do not show a consistent pattern. Some differences in growth of lymphoreticular tissues (spleen, thymus, mesenteric lymph node, liver) were observed but are not attributable to differences in cell number. A comparison of humoral antibody response (anti-sheep red blood cell, Jerne plaque assays) shows that 20 week old irradiated males achieve peak response a day later than the controls. In terms of plaques/million spleen cells the peaks are of similar magnitude. (auth)

50918 (COO-3017-44) RADIATION CARCINOGENESIS. Six-Year Summary Progress Report, May 1, 1966—April 30, 1972. Warren, Shields; Gates, Olive (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). 1972. Contract AT(11-1)-3017. 57p. Dep. NTIS.

CARBON-14—incorporation into DNA in mouse tissues following long-term inhalation in air
—uptake and distribution in mouse tissues following long-term inhalation in air
GAMMA RADIATION—effects on rats following continuous high dose rate internal exposure from cobalt-60 sources placed adjacent to bones and in uterus, incidence of carcinogenic
—effects on fertility, growth, life span, and tumor incidence in unexposed progeny of mice receiving perinatal whole-body exposure
—effects on mice under conditions of perinatal medium dose rate whole-body exposure from cobalt-60 source in dam, effects of time of exposure on incidence of carcinogenic
—effects on mice under conditions of ambient very low dose rate life-time whole-body exposure, incidence of carcinogenic
—effects on tissues of rodents under conditions of continuous internal exposure from cobalt-60 sources placed in selected sites, correlations between dose, dose rate, time and incidence of carcinogenic
—effects on epithelial tissues of rodents under conditions of continuous long-term high dose internal exposure from intrathoracic cobalt-60 source, effects of constitutional and genetic factors on incidence of carcinogenic
NEOPLASMS—tumors, incidence of benign and malignant breast, in rats following treatment with dimethylbenzanthracene
RADIATION—effects on morphology and viability of transplanted human tumors following repeated exposures and transplantations
X RADIATION—effects on parabiont rats following acute whole-body exposure of one partner, incidence of carcinogenic
(E.R.B.)

50919 (COO-3167-28) PHASE I: RADIATION AND RADIOISOTOPE STUDIES WITH LABORATORY AND DOMESTIC ANIMALS. PHASE III: STUDIES ON NEURAL AND BEHAVIORAL RESPONSE TO RADIATION. PHASE IV: BIOLOGICAL EFFECTS OF IMPLANTED NUCLEAR ENERGY SOURCES FOR ARTIFICIAL HEART DEVICES. Progress Report, July 1, 1971—May 31, 1972. Comar, C. L. (New York State Veterinary Coll., Ithaca. Dept. of

Physical Biology. Cornell Univ., Ithaca, N. Y.). 1972. Contract AT(11-1)-3167. 256p. Dep. NTIS.

AVES—Gallus sp. (chicken), phosphate uptake by intestines of, effects of vitamin D and other variables on, phosphorus-32 tracer study

—Gallus sp. (chicken), calcium metabolism in normal and rachitic, effects of vitamin D on

BEHAVIOR—radiation effects on learning, of rats following exposure to mixed gamma-neutron

BETA PARTICLES—effects on embryo development, chronic internal strontium-90-yttrium-90 and tritium

—effects on mice following intraperitoneal injection of strontium-90-yttrium-90, dose dependence of embryo development and reproductive capacity

BIOLOGICAL MODELS—development for estimation of radiation dose to man following uptake of fallout radioisotopes in milk

—development for calcium transport kinetics through mammary gland to milk

CALCIUM—metabolism in animals, relation of vitamin D induced intestinal protein binding to

—incorporation in milk, kinetic model based on calcium-45 tracer study in lactating guinea pigs

CATTLE—calcium metabolism in, relation of vitamin D induced intestinal protein binding to, calcium-47 tracer study

CESIUM-134—radiation dose to man following uptake in milk of fallout, biological model for prediction of

CESIUM-137—radiation dose to man following uptake in milk of fallout, biological model for prediction of

CHROMIUM-51—distribution and retention in tissues of dogs following intravenous injection as labeled serum albumin

—distribution and retention in tissues of horses following intravenous injection as labeled serum albumin

DOGS—chromium-51 distribution and retention in tissues of, following intravenous injection as labeled serum albumin

—thyroid function studies using iodine radioisotopes as tracers

—effects of implantation of radioisotope heat sources used for powering artificial human hearts on physiology of, californium-252 and strontium-90

EMBRYOS—radiation effects on cellular development of mammalian, comparison of chronic internal strontium-90-yttrium-90 and tritium beta with chronic external γ

FOOD CHAINS—radioisotope transport through pasture grass-cattle-milk-man, following deposition in fallout, biological model for prediction of radiation dose to man following

FRUITS—iodine-131 removal from, following deposition in fallout, methods for

GAMMA RADIATION—effects on embryo development, chronic external

—effects on learning behavior of rats following exposure to mixed neutron and

GOATS—mercury transport from environment to milk of, mercury-203 tracer study

GUINEA PIGS—calcium transport to milk in lactating, kinetic model based on calcium-45 tracer study

HAMSTERS—calcium metabolism in, relation of vitamin D induced intestinal protein binding to, calcium-47 tracer study

HEAT SOURCES—effects on dogs following implantation of californium-252 and strontium-90, physiological

HORSES—chromium-51 distribution and retention in tissues of, following intravenous injection as labeled serum albumin

IODINE-129—radiation dose to man following uptake in milk of fallout, biological model for prediction of

IODINE-131—radiation dose to man following uptake in milk of fallout, biological model for prediction of

—removal from fruits and vegetable plants following deposition in fallout, methods for

IODINE-133—radiation dose to man following uptake in milk of fallout, biological model for prediction of

IODINE-135—radiation dose to man following uptake in milk of fallout, biological model for prediction of

MAMMARY GLANDS—calcium transport to milk in, of guinea pigs, kinetic model based on calcium-45 tracer study

MAN—radiation dose to, following uptake of fallout radioisotopes in milk, biological model for prediction of

MERCURY—transport of inorganic, to milk of goats, mercury-203 tracer study

MICE—radiation effects on embryo development in, following intraperitoneal injection of strontium-90-yttrium-90, dose dependence of β

—radiation effects on reproductive capacity of, following intraperitoneal injection of strontium-90-yttrium-90, dose dependence of β

MILK—mercury transport from environment to, of goats, mercury-203 tracer study

NEUTRONS—effects on learning behavior of rats following exposure to mixed gamma and

PHOSPHATES—uptake by intestines in chickens, effects of vitamin D and other variables on, phosphorus-32 tracer study

PLANTS—iodine-131 removal from vegetable, following deposition in fallout, methods for

RATS—radiation effects on learning behavior of, following exposure to mixed gamma-neutron

STRONTIUM-89—radiation dose to man following uptake in milk of fallout, biological model for prediction of

STRONTIUM-90—radiation dose to man following uptake in milk of fallout, biological model for prediction of

THYROID GLAND—function studies of, in dogs using iodine radioisotopes as tracers

VEGETABLES—iodine-131 removal from, following deposition in fallout, methods for (C.H.)

50920 (EUR-4810(Vol.1), pp 1-29) ROLE OF MICRODOSIMETRY IN RADIOBIOLOGY AND RADIATION PROTECTION. Rossi, Harald H. (Columbia Univ., New York).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Interest in theoretical radiobiology continues to be strong since apart from intrinsic concerns those of radiation protection and radiotherapy are involved. Microdosimetry was developed in the hope that a correlation between microscopic patterns of energy deposition and biological effect would permit conclusions concerning the actions of ionizing radiation, particularly in regard to the production of primary lesions. The traditional approach via dose-effect relations has serious limitations that tend to be reduced or eliminated when RBE is considered. Dependence of RBE on three other physical characteristics may be considered. These are radiation quality, absorbed dose, and dose rate. Of these, the most fruitful thus far has been a consideration of RBE as a function of absorbed dose. This has led to the Theory of Dual Radiation Action with its main thesis that the biological effect of radiation on many systems in higher organisms depends on the square of specific energy. Studies of RBE as a function of both radiation quality and dose rate support this contention. The theory indicates that microdosimetry needs to be carried out over dimensions that differ by about three orders of magnitude. It appears that the most significant data will be obtained in the micrometer and the nanometer region. (auth)

50921 (EUR-4810(Vol.1), pp 217-35) INVESTIGATIONS OF THE TEMPERATURE-DEPENDENT BEHAVIOR OF RADIOINDUCED RADICALS IN CELL SUSPENSIONS: A CONTRIBUTION TO THE PROBLEM OF ENERGY TRANSFER. Grillmaier, R. E.; Muth, H. (Univ. of Saarlandes, Saarbruecken, Ger. Boris Rajewsky Inst., Homburg, Ger.). (In German).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

It was observed that in water of the cell suspension at 90°K only OH$^{\cdot}$ radicals but no free electrons or H$^{\cdot}$ radicals are present and that the OH$^{\cdot}$ radicals recombine at very low temperatures without a change of the concentration of bioradicals. On the other side there is a certain degree of evidence that a fraction of the H$^{\cdot}$ radicals or of the free electrons react with biomolecules or are trapped by them. The bioradical concentration remains constant over a wide range of temperature. Only the glycerol containing cell suspension shows an extraordinary change of the shape of the EPR-spectrum in the higher range of temperature, combined with an increase in radical concentration, which both must be due to the action of glycerol, which is known as radioprotective agent. The dependency of radical concentration in cell suspensions and water at 90°K and 150°K on radiation dose shows a linear dose relationship and a dose relation factor of about 9×10^{12} of bioradicals/g.R. Chromosome aberration analysis of a part of the frozen and irradiated cell suspensions shows that the radiation effect is only $^1/_{16}$ resp. $^1/_{46}$ of the deletion rate and rate of dicentrics and rings at room temperature. From chromosome aberration rate per cell and dose unit and the dose relation factor of radicals the order of magnitude of the ratio of bioradicals per chromosome break is estimated. (auth)

50922 (FRNC-R-9) CHEMICAL RADIATION PROTECTION. Frossard, Sylvain (Centre de Recherches du Service de Sante des Armees, Clamart (France). Division d'Hygiene Atomique). 28 Jul 1971. 103p. (In French). Dep. NTIS (U. S. Sales Only).

The different modes of action of radioprotective substances are investigated: protection obtained by radiochemical mechanisms or biochemical and physiological mechanisms. Observations of the death rate of irradiated mice having received an intraperitoneal injection of radioprotective substances together with various biochemical and physiological investigations facilitated the determination of the efficiency of the protective substances. The systematized screening methods adopted by the Center de Recherches du Service de Sante des Armees are discussed. Results concerning the toxicity, pharmacology, and efficiency of various radioprotective substances with or without the SH group are presented. Recent advances in the understanding of the mechanisms, the utilization of protective substances, and the development of new substances are described. (France)

50923 (NYO–2071-58) RADIATION AND TERATOGENESIS IN PREGNANCY. Brent, Robert L. (Jefferson Medical Coll., Philadelphia, Pa.). 1971. 30p. Dep. NTIS.

The classical results that one associates with the effects of irradiation on the mammalian embryo are: intrauterine and extrauterine growth retardation; embryonic, fetal, or neonatal death; and gross congenital malformations. The structure most readily and consistently affected by irradiation is the central nervous system. If the acute in utero dose is below 25 R, these classical effects of irradiation are never observed together in experimental animals nor, in all likelihood, in the human. This, of course, does not mean that there are not other embryopathological effects that can be produced with this level of radiation exposure. Although the preimplanted embryo is sensitive to the lethal effects of irradiation having an LD/50 below 100 R at some stages, it is not readily malformed by irradiation. In fact embryos at this stage of embryonic development which survive radiation exposure are developmentally normal and exhibit normal intrauterine and extrauterine growth. There are several experimental exceptions to this rule and they are discussed. The peak incidence of gross malformations are produced by irradiation during the early organogenetic period, although cellular, tissue, and organ hypoplasia can be produced by irradiation throughout the organogenesis fetal and neonatal period, if the dose is high enough. Growth retardation at term results from irradiation of the implanted embryo and exposure throughout the remainder of gestation. Thus, although the growth of the surviving embryo exposed during pre-implantation is not retarded, the implanted embryo shows retardation of growth before it is susceptible to the malforming effects of irradiation. The embryonic LD/50 dose of irradiation is lowest during the preimplantation period, rises during implantation, and falls again during organogenesis. On the first day of gestation 10 R results in an increase in embryonic mortality. From this stage on the LD/50 gradually rises until it approximates the adult LD/50 in the late fetal stages. The neonatal death rate following irradiation is highest in the surviving embryos irradiated during the early organogenetic period. There is no stage of gestation during which 50 R will not have a significant embryopathologic effect; death during the preimplantation period, malformations during the early organogenetic stage, and cell deletions during some fetal stages. (68 references). (auth)

50924 (TID–25857, pp 72-86) RADIATION HAZARD FOR MAN. Gofman, John W. (Univ. of California, Livermore. Univ. of California, Berkeley). 1972.

In Environmental and ecological forum, 1970–1971.

The somatic and genetic hazards of ionizing radiation for man are discussed. Data previously published from studies on laboratory mammals on the relation of radiation dose and dose rate to the induction of cancer and leukemia and the genetic effects of irradiation are reviewed. The relevance of the animal data for estimating the response of man to radiation is discussed. (C.H.)

50925 (UR–3490-171) INVESTIGATION OF THE DOSE DISTRIBUTION ASSOCIATED WITH LOWER BODY X-IRRADIATION ON THE ^{59}Fe UPTAKE IN RAT BONE MARROW. Yalcintas, M. Guven (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 60p. Dep. NTIS.

Results are reported from studies on the effects of x irradiation of hematopoietic tissues in rats on erythropoiesis, as measured by the uptake of trace amounts of injected ^{59}Fe by bone marrow and spleen. As the dose of x radiation was increased, its effect on erythropoiesis became more profound. The dose distribution in shielded and unshielded body portions was measured using implanted LiF and CaF_2 thermoluminescent dosimeters. (C.H.)

50926 SYNAPTIC PRESERVATION IN OLD POST X-IRRADIATION LESIONS (EEG AND ELECTRON MICROSCOPE OBSERVATION). Roizin, L.; Caveness, W. F.; Carsten, A. L.; Liu, J. C. Trans. Amer. Neurol. Ass.; 96: 295-7(1971).

A total of 3500 rad of x radiation was administered to the right visual cortex of six monkeys (Macaca mulatta). Procedures are described for electroencephalographic examinations and electron microscope examinations of brain tissue. The EEG observations revealed that the evoked responses of the visual cortex to photic stimulation gave a consistent pattern at all stimulation frequencies employed. This consisted of a variable decrease in amplitude of the response from the irradiated side when compared with those from the non-irradiated side. The pathological findings on the irradiated side revealed various degrees of neuronal loss and disorganization of the cell structures associated with alteration and loss of myelin structures and blood vessels. (H.L.W.)

50927 ROLE OF TRANSPLANTED SLOWLY PROLIFERATING BONE MARROW CELLS FOR REGENERATION OF LETHALLY X-IRRADIATED RAT BONE MARROW. Haas, R. J.; Meyer-Hamme, K.; Fliedner, T. M.; (and others) (Univ., Ulm, Ger.). Scand. J. Haematol.; 9: 121-9(1972).

Inbred Lewis rats were labelled with ^{3}H-thymidine (^{3}H-TdR) in utero and for 6 weeks after birth to obtain 100% labelling of all the cells in the animals 6 weeks after the last ^{3}H-TdR injection only cytokinetically resting cells were still labeled. These cells comprise two types of reticular cells, endothelial cells and a small fraction of bone marrow lymphocytes. At this time the animals were treated with 4 × 500 mg/kg body weight hydroxyurea (HU) at 6-h intervals. A profound marrow hypoplasia was obvious 6 h after the last HU injection. All proliferating precursor cells of the bone marrow were destroyed, whereas the cytokinetically resting cells were not changed in their absolute number. Successful transplantation of the marrow treated with HU to 1200 R x-irradiation recipients provided evidence for the presence of stem cells in the bone marrow of the donors and indicated that in rats bone marrow regeneration can be achieved in the absence of cells morphologically defined as haemocytoblasts. (auth)

50928 REGULATION OF HAEMOPOIETIC STEM CELL TURNOVER IN PARTIALLY IRRADIATED MICE. Gidali, J.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Cell Tissue Kinet.; 5: No. 2, 147-57(Mar 1972).

The existence of a possible local control of colony forming units (CFU) turnover was studied in mice in which one tibia only was irradiated (LR mice) and in mice in which one tibia was shielded during whole-body irradiation (''TBR'' mice). In both the LR and ''TBR'' mice, the increased CFU turnover continued in the irradiated tibiae even after the time when in the unirradiated (shielded) tibiae it returned to normal levels. The early temporary decrease in the CFU numbers in the shielded tibiae of ''TBR'' mice is attributed to a temporary demand for increased differentiation rather than to migration of CFU. The direct control of CFU turnover appears to be local in nature, in contrast to the stimulus for CFU differentiation. (auth)

50929 MULTIPLICATION OF HEMOPOIETIC COLONY FORMING UNITS (CFU) IN MICE AFTER X-IRRADIATION AND BONE MARROW TRANSPLANTATION. Vos, O. (Medical Biological Lab. TNO, Rijswijk, Netherlands). Cell Tissue Kinet.; 5: No. 4, 341-50(Jul 1972).

Kinetics of the multiplication of hemopoietic CFUs was studied in lethally irradiated mice receiving various numbers of syngeneic bone marrow cells. After transplantation of a small number of bone marrow cells, the growth rate of CFU in femoral bone marrow appeared to decrease after about 10 days after transplantation, before the normal level of CFU in the femur was attained. In the spleen, it was found that the overshoot that was observed about 10 days after transplantation of a large number of bone marrow cells was smaller or absent when a small number of cells was transplanted. Experiments dealing with transplantation of 50 × 10^6 bone marrow cells 0, 4, or 10 days after a lethal irradiation indicated that the decline in growth rate of CFUs about 10 days after irradiation could not be attributed to environmental changes in the host. The results are explained by the hypothesis that a previous excessive proliferation of CFUs diminishes the growth rate thereafter. This hypothesis is supported by experiments in which 50 × 10^6 bone marrow cells derived from normal mice or from syngeneic chimaeras were transplanted. The slowest growth rate was observed when bone marrow that had been subjected to the most excessive proliferation in the weeks preceding the experiment was transplanted. (auth)

50930 ULTRASTRUCTURAL AND CELLULAR EFFECTS OF IONIZING RADIATION. Phillips, Th. L.; Benak, S.; Ross, G. (Univ. of California, San Francisco). Front. Radiat. Ther. Oncol.; 6: 21-43(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Rats were exposed to x radiation doses between 500 and 3,000 rads over localized areas in the thorax and to the kidney. Samples were prepared for electron microscopy one hr to one year after exposure. No significant damage was seen in heart, skeletal muscle, lung, or kidney until about two months after irradiation. The common site of damage in all four organs was the capillary endothelium. Injury appeared between two and four months and was repaired between four and eight months. Residual damage was sharply dose related and was minimal below 1,500 rads. The kidney was unique among the four organs studied in that extensive tubule damage was seen in addition to capillary damage. (auth)

50931 RADIATIONS AND THE MICROCIRCULATION. Reinhold, H. S. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Front. Radiat. Ther. Oncol.; 6: 44-56(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review is presented of the effects of radiation on the morphology and functioning of the capillary bed. Topics discussed are radiation effects on permeability changes in endothelium, dose-effect relationships for endothelial cell killing, and characteristics of proliferating endothelium. It was concluded that cell killing by irradiation is not the main factor in causing disturbances which occur within the first 24 hr after irradiation, but that the intermediate and late effects may be related to cell death. (H.L.W.)

50932 RADIATION EFFECTS ON RAPIDLY AND SLOWLY PROLIFERATING CELL RENEWAL SYSTEMS. Fabrikant, J. I. (Univ. of Connecticut, Farmington). Contract No. AT (30-1)-3970. Front. Radiat. Ther. Oncol.; 6: 57-78(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review is presented of the mechanisms that influence cell renewal following radiation injury of the small intestine, erythropoietic tissue, and seminiferous epithelium. Observations of changes in the proliferative characteristics of tissues during and following irradiation indicate that the cell population kinetics of the tissue have a considerable effect on the radiation response. Of the tissues studied, the small intestine has the highest radiation tolerance, the testis the lowest, and the hematopoietic tissues are intermediate between the two. In rapidly dividing cell systems, there is an effective elimination of damaged cells with almost complete repair of nonlethal cellular damage. The changes in cell population kinetics during and after irradiation include a shortening of the cell cycle and a lengthening of the transit time of the precursors in the proliferative compartment. In slowly dividing systems, such as the liver and kidney, there is some repair of radiation damage during interphase, and the pattern of cell proliferation during regeneration is relatively little disturbed by prior protracted irradiation. (H.L.W.)

50933 CELL RENEWAL SYSTEM CONCEPTS AND THE RADIATION RESPONSE. Withers, H. R. (Univ. of Texas, Houston). Front. Radiat. Ther. Oncol.; 6: 93-107(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Three factors are known to influence the response of tissues to fractionated irradiation: repair of sublethal injury, redistribution of surviving cells within the division cycle, and repopulation by clonogenic cells. A fourth factor, reoxygenation is important in the fractionation response of animal tumors, but is not considered here because, although hypoxia and reoxygenation may influence the age density distribution and hence the dose response, their main effect is probably not related to division cycle phenomena. The capacity of cells for repair of sublethal damage varies greatly with their position in the division cycle. The sensitizing effect of redistribution will be strongly dependent upon the proportion of the cells in phases of the cycle characterized by little or no repair capacity. The effectiveness of a regenerative response in producing repopulation by clonogenic cells depends most upon a change in the cell loss rate. Repopulation influences the radiation dose necessary for an iso-effect. Since the cell loss factor in steady state tissues is 1.0, and in tumors must be <1, there exists at the outset of therapy, a potential relative benefit to the tumor from ultrafractionation or low dose rate continuous irradiation (LDR). An advantage to normal tissues can only derive from their earlier and/or more rapid regenerative response. From the above, it may be reasoned that when tumors are seated in non-proliferative host tissues (e.g., liver, brain, or to a lesser extent, lung), the maximum therapeutic ratio may be derived from ultrafractionation or LDR. The spacing of the fractionation intervals and the overall treatment time, or the dose rate for continuous exposure, could be optimized if the detailed growth kinetics of the tissues were known. Although ultrafractionation has been proposed, the same arguments favor conventional fractionation. Several factors that influence the response of a tissue to fractionated irradiation have been considered: fluctuation in radiosensitivity throughout the cell cycle, distribution density of sensitive and resistant cells in tissues, redistribution rate after irradiation, cell cycle time, cell-loss factor, size and frequency of dose per fraction and dose rate of LDR. Although some quantitative values were assumed to illustrate the discussion it should be re-emphasized that these values are assumed and may not relate to the real situation in normal and malignant tissues being irradiated. (auth)

50934 X-IRRADIATION OF THE HEMATOPOIETIC STEM CELL COMPARTMENT. Hellman, S. (Harvard Medical School, Boston). Front. Radiat. Ther. Oncol.; 6: 415-27 (1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review is presented of four basic effects of radiations on the hematopoietic stem cell compartment. The initial peripheral blood responses often reflect changes in these proliferative compartments, especially when one is studying the effects of chemotherapeutic agents, while late effects on the bone marrow depend on vascular and stromal alteration. However, ultimate bone marrow survival following whole body irradiation or other cytotoxic agents depends upon the stem cell compartment. In this paper, we have tried to review how irradiation affects this compartment. Stem cells have a survival curve similar to most mammalian cells. Following irradiation, surviving cells initially have an altered capacity for differentiation and favor granulopoietic differentiation at the expense of erythropoietic differentiation. As they recuperate, the milieu of the recuperating animal reverses this trend and favors erythropoiesis at the expense of granulopoiesis. The normal stem cell population is only slowly proliferating, but in response to significant cell depletion caused by radiations, it markedly increases its proliferative rate. These proliferating stem cells vary in their radiation response, depending on their position in the cell cycle. (auth)

50935 IRRADIATION AND THE IMMUNE RESPONSE WITH PARTICULAR REFERENCE TO THYMIC-DEPENDENT MECHANISMS. Anderson, R. E.; Doughty, W. E. (Univ. of New Mexico, Albuquerque). Front. Radiat. Ther. Oncol.; 6: 445-58(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review of studies on the radiosensitivity of the components of the immune process revealed that the most radiosensitive cells are the lymphocytes. Studies on radiation effects on the antibody response in rabbits showed that the response consists of three phases: suppression of antibody formation when exposure precedes immunization by 12 hr to several weeks; postponement of maximum antibody synthesis when exposure postdates immunization by 12 to 24 hr; and enhancement of antibody production when the physical event follows sensitization by 24 to 36 hr. Studies on effects of radiation on transplantation immunity showed that homografts were accepted by irradiated rabbits for a significantly longer period than by nonirradiated controls. Studies on thymectomized mice showed that the thymus is essential for the normal development and function of the lymphoreticular system and the normal expression of the immune response. An intact thymus appears to be essential for complete recovery from extensive radiation injury. (H.L.W.)

50936 GENETIC EFFECTS AND RADIATION-INDUCED CELL DEATH. Wolff, Sheldon (Univ. of California, San Francisco). Front. Radiat. Ther. Oncol.; 6: 459-69(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

A review is presented of the radiosensitive targets in the cell and the modification of their response in rapidly dividing cells and under dose fractionation regimes. Target theory studies are discussed in relation to effects of LET on the radiosensitivity of cell nuclei. Radioinduced lesions in the nucleus that lead to cell death are DNA strand breakage, point mutations, and chromosome aberrations. A discussion is given of these lesions. (H.L.W.)

50937 AGING. Casarett, G. W. (Univ. of Rochester, N. Y.). Front. Radiat. Ther. Oncol.; 6: 479-85(1972).

From sixth annual cancer symposium; San Francisco, CA. (16 Oct 1970). See CONF-701071.

Basic, progressive, degenerative changes in tissues and organs associated with aging in adult mammals are briefly described. The similarity of the sequential pattern of changes due to ionizing radiation and those due to aging is pointed out. A review is given of phases of the development of fibrosis following irradiation of rabbits and rats. The changes include increase in fibroblastic cells, increase in the connective tissue barrier, changes in hydroxyproline and hexosamine, necrosis of parenchyma, and occlusion of small arteries. Experimental studies on the influence of age on susceptibility to radiation damage indicate that increasing age may cause a decrease in resistance to the lethal effect of radiation, although the time and pattern of decrease may vary widely among species and strains. (H.L.W.)

50938 EFFECTS OF TOTAL EXPOSURE TO ^{60}Co γ-RADIATION ON CEREBRAL NICOTINAMIDE NUCLEOTIDES AND GLUTATHIONE IN DOGS. Pausescu, Exacustodian; Teodosiu, Traian; Chirvasie, Rodica (Fundeni Clinical Hospital, Bucharest). Radiat. Res.; 51: No. 2, 302-9(Aug 1972).

In two groups of dogs irradiated with ^{60}Co γ rays (300 and 600 rads, respectively) a marked decrease in the content of nicotinamide nucleotides and reduced glutathione of the brain nuclear, mitochondrial, and cytoplasmic fractions was found. From the statistical and correlative analysis of the experimental results, it was concluded that: this change is essentially related to the radiation dose; it is quantitatively different from one compound to another and from one subcellular fraction to another; it appears to be a reflection of strong breakdown of these compounds rather than a reflection of synthesis disturbance; and it is possible that cerebral nuclear nicotinamide nucleotide depletion, especially in reduced forms, plays an important role in the mammalian radiation lethality. The results provide evidence for effective attempts in the radioprotection. (auth)

50939 BIOLOGICAL EFFECTS OF RADIATION. Coggle, J. E. Wykeham Science Series, No. 14. New York; Springer-Verlag New York, Inc. (1971). 156p. $5.60.

The subject is discussed under the following chapter headings: some properties of ionizing radiation; the effect of radiation at the molecular and subcellular levels; cellular effects of radiation (two chapters); radiation effects on cell survival in vivo; the effect of radiation at the tissue level; the genetic effects of ionizing radiation; some factors that modify the biological effects of radiation; radiation and cancer induction; radioinduced life-shortening; and radiation hazards and the standards for radiation protection. A brief glossary and subject index are included. (E.R.B.)

50940 DIFFERENTIAL RADIOSENSITIVITY OF RAT BLASTOCYSTS DURING DELAYED IMPLANTATION. Ward, W. F.; Meyer, R. K.; Wolf, R. C. (Univ. of Wisconsin, Madison). Proc. Soc. Exp. Biol. Med.; 140: No. 3, 797-801(Jul 1972).

Mitotically active rat blastocysts on Day 5 of castration-induced delayed pregnancy are initially more sensitive to the lethal effects of x-irradiation in vivo than are mitotically dormant blastocysts on Day 9. However, embryonic survival in animals irradiated on Day 5 increases significantly if implantation is postponed for 24 or 48 hr, indicating that recovery from potentially lethal x-ray damage can occur during early delayed implantation. Although the quiescent blastocyst on Day 9 of delayed pregnancy is initially more resistant to radiation insult than is the embryo on Day 5, the former exhibits no capacity to repair lethal x-ray damage. (auth)

50941 REGENERATION OF THYMUS, SPLEEN AND BONE MARROW IN X-IRRADIATED AKR MICE. Decleve, A.; Gerber, G. B.; Leonard, A.; (and others) (Nuclear Energy Study Center, Mol, Belgium). Radiat. Res.; 51: No. 2, 318-32(Aug 1972).

Regeneration of thymus, spleen, and bone marrow of AKR/T1 Ald mice after whole-body irradiation with 605 rad (650 R) with or without treatment with 10^7 syngeneic bone marrow cells from AKR mice was followed. In the non-transplanted irradiated animals, cell division recommences first in the thymus (on day 6) following the biphasic pattern observed by others. Cell division in spleen (day 8) and bone marrow (day 8 to 12) resumes later. After bone marrow treatment, all these organs begin to regenerate at about day 6 and also display a biphasic pattern of cell divisions. The proportion of donor cells remains high in bone marrow and spleen, but drops temporarily in thymus, perhaps as the result of division of damaged thymus cells. The data interpreted in a semiquantitative way suggest that the assumption that the thymus is seeded from bone marrow is not needed to explain a biphasic pattern of thymus regeneration, rather it appears likely that cells present in thymus or deposited there immediately after injection of bone marrow cells can engender a full regeneration of the thymus. (auth)

50942 EFFECT OF X-IRRADIATION ON THE THYROID GLAND OF BEAGLES FED A RESTRICTED IODIDE DIET. Fritz, T. E.; Norris, W. P.; Taylor, J. A.; Kretz, N. D. (Argonne National Lab., Ill.). Radiat. Res.; 51: No. 2, 333-60 (Aug 1972).

When the usual iodide intake of beagles was reduced to 50 to 75 μg/day, their thyroid glands responded by cellular hyperplasia and hypertrophy, loss of colloid, and increased glandular weight. After about 1 yr, the enlarged thyroid glands had accommodated to reduced dietary iodine and presented a normal histologic appearance. When both thyroid lobes of similarly fed beagles were exposed to 2000 R of 250 kVcp x rays, there was cellular hypertrophy and loss of colloid, but cellular hyperplasia and increased glandular size and weight did not occur. The irradiated glands did not regain a normal histologic appearance, but became fibrotic. If only one lobe of the thyroid was irradiated, the irradiated lobe became fibrotic, while the unirradiated lobe responded to the change in iodine intake as if neither lobe had been irradiated. When the enlarged unirradiated lobe had reverted to a more normal histologic appearance, the irradiated gland responded similarly, but was not increased in size. All histologic changes correlated with changes in iodide metabolism, measured by repeated tests using ^{131}I. Hyperplastic glands accumulated large fractions of tracer doses of ^{131}I, but released iodine more rapidly than did normal-appearing glands. The reversion of such hyperplastic glands to a normal histologic appearance was characterized by an abrupt decrease in the rate of release of ^{131}I, with ^{131}I uptake remaining high. (auth)

50943 LD$_{50}$ AND THE SURVIVAL OF BONE-MARROW COLONY-FORMING CELLS IN MICE: EFFECT OF RATE OF EXPOSURE TO IONIZING RADIATION. Krebs, John S.; Jones, David C. L. (Stanford Research Inst., Menlo Park, Calif.). Radiat. Res.; 51: No. 2, 374-80(Aug 1972).

Mice were exposed to gamma radiation from ^{60}Co sources at 1750 R/hr and at 190 R/hr. The 30 day LD$_{50}$ was 873 R at 1750 R/hr and 1359 R at 190 R/hr. Survival curves of bone-marrow colony-forming cells measured between 100 and 500 R had values of D$_0$ of 90.1 R for the 1750 R/hr exposure rate and 92.9 R for the 190 R/hr exposure rate. The corresponding extrapolation numbers of the survival curves were 1.93 and 1.83. It is concluded that a difference in rate of exposure to radiation sufficient to result in a large difference in the LD$_{50}$ is not necessarily associated with a corresponding difference in response of the bone-marrow colony-forming cells to the radiation. (auth)

50944 DOSE-DEPENDENCE OF FAST NEUTRON RBE FOR LENS OPACIFICATION IN MICE. Bateman, J. L.; Rossi, H. H.; Kellerer, A. M.; Robinson, C. V.; Bond, V. P. (Columbia Univ., New York. Brookhaven National Lab., Upton, N. Y.). Radiat. Res.; 51: No. 2, 381-90(Aug 1972).

Opacification of the optic lens in mice was evaluated after exposure to the following radiations and doses: 250 kVp x rays, 4.5 to 1,000 rads; 14 MeV neutrons, 0.5 to 60 rads; 1.8 MeV neutrons, 1 to 36 rads; and 0.43 MeV neutrons, 0.02 to 104 rads. Highly refined techniques of serial in vivo lens examination and scoring of minute defects (opacities) were employed for this very radiosensitive system. Data analysis was based on the relative accumulation of opacities in irradiated compared to untreated lenses. (Both revealed the same degenerative process.) A non-parametric analysis of the observation discloses that the RBE is inversely proportional to the square root of the neutron dose and that it can reach values in excess of 100. The findings are in accord with the theory of dual radiation action. (auth)

50945 IRREPARABLE INTERPHASE INJURY PRODUCED BY X-IRRADIATION OF THE RAT THYMUS IN VIVO. Jackson, K. L.; Christensen, G. M. (Univ. of Washington, Seattle). Radiat. Res.; 51: No. 2, 391-401(Aug 1972).

The present investigation was carried out to determine if thymocyte radiation injury leading to interphase death is repaired in vivo. For this purpose either thymus DNA (an index of cell number) or thymus cell number was measured following single and fractionated whole-body x irradiation. Three days after single exposures, thymus DNA decrease was determined to be dose dependent within the range of 0 to 175 R. The principal mechanism for this rapid decrease in DNA has previously been shown to be due to interphase death. Two 75-R exposures separated by 4 hrs reduced the number of thymus cells and thymus DNA to the same extent as a single 150-R exposure. Additional experiments showed no differences in DNA content of the gland with intervals between exposures of 2 and 7 hrs. Fractionation intervals of 10, 15, and 20 hrs resulted in increased DNA as compared to single exposure. Measurement of the mitotic index in the thymus as a function of time after a single exposure of 75 R suggests that increased DNA in the gland after fractionation intervals greater than 7 hrs is the result of cell division completed between fractions. Therefore, the method cannot be used to study recovery when fractionation intervals exceed 7 hrs. Within this limitation, the study shows no detectable recovery of radiation injury leading to interphase death in vivo. (auth)

50946 INCREASED EMBRYO PRODUCTION FOLLOWING LOW DOSES OF RADIATION TO TROUT SPERMATOZOA. Newcombe, Howard B.; McGregor, John F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Res.; 51: No. 2, 402-9(Aug 1972).

An observed "beneficial" effect from low doses of radiation is described. When mature sperm of rainbow trout were exposed to 25 and 50 rad, the ratios of eggs with embryos to eggs without embryos were significantly increased by approximately 35 and 40%, respectively, as compared with the control. With the higher dose of 400 rad to the sperm, the effect was unconditionally "harmful" and the yield of embryos was greatly reduced. It is suggested that the beneficial effect may be due to changes in the protein of the sperm and the harmful effect to changes in the DNA. (auth)

50947 RADIOAUTOGRAPHIC STUDIES ON THE [^{3}H] URIDINE INCORPORATION INTO THE MOTOR NEUTRONS OF THE SPINAL CORD OF X-IRRADIATED MICE. Olkowski, Zbigniew (Emory Univ., Atlanta). Radiat. Res.; 51: No. 2, 280-92(Aug 1972).

The incorporation of [^{3}H]uridine into the cytoplasm and the nuclei of the motor neurons of the spinal cord of control mice and mice given whole-body x irradiation was studied with the use of radioautography. A decrease in isotope incorporation into the cell cytoplasm as well as into the nuclei 0.5 to 5 h after irradiation was observed. At 8 and 12 h after irradiation, the intensity of [^{3}H]uridine incorporation into the nuclei increased, whereas the radioactivity of the cytoplasm of the motor neurons of mice in these experimental groups remained lower than the appropriate control values. It appears possible that ionizing radiation inhibits the RNA synthesis in the nuclei of the motor neurons. (auth)

50948 DETERMINATION OF THE IRRADIATION DOSE INHIBITING THE RENEWAL OF THE INTESTINAL EPITHELIUM OF SWINE. Chardon, Patrick; Daburon, Francois; Nizza, Pierre (CEA, Jouy-en-Josas, France). Compt. Rend., Ser. D; 274: No. 14, 2090-3(5 Apr 1972). (In French).

The cell variations occurring in the intestinal epithelium between 50 and 100 hrs after swine were whole-body γ-irradiated were studied by observing the DNA in the ileum segments. With doses exceeding 1500 rads, no spontaneous renewal of the epithelial cell was observed. (France)

50949 VOLUME DISTRIBUTION CURVES OF RAT ERYTHROCYTES AFTER WHOLE-BODY IRRADIATION. Valet, Von Guenter; Metzger, Helmut; Kachel, Volker; Ruhenstroth-Bauer, Gerhard (Max-Planck-Institut fuer Biochemie, Munich). Blut; 24: No. 5, 274-82(May 1972). (In German).

The changes of the volume distribution curves of rat erythrocytes are described from 0 to 270 days after a 600 R whole-body x irradiation. The volume distribution curves were measured with Coulter capillaries modified by a particle-beam attachment. From 21 to 63 days after irradiation a macrocytic erythrocyte population M appears in the blood, which is of a Gaussian distribution type as the normal rat erythrocyte population. The analysis of the distribution type and the calculation of the number of cells of the different erythrocyte populations in the whole rat after irradiation indicates a shortened rather than a normal life span of the macrocytic erythrocyte population. No indications for the reappearance of the previously described erythrocyte populations I, II, and III of newborn and young rats were found in animals that were x-irradiated at about 50 days of age. (auth)

50950 EFFECT OF GAMMA IRRADIATION ON THE ANTITHIAMINE ACTIVITY OF SKIPJACK TUNA. Hilker, Doris M.; Tang, Nora Yu- Ang; Chan, King-Cham (Univ. of Hawaii, Honolulu). J. Food Sci.; 37: No. 4, 596-8(1972).

The effects of γ irradiation at doses ranging from 0.5 Mrad to 4 Mrad on the non-enzymatic antithiamine activity in tissue samples and isolated protein fractions of Skipjack tuna, Katsuwonus pleamis, exposed in air and under anoxic conditions were studied. The antithiamine activity of samples irradiated in air at doses of 2 to 4 Mrad, but not 1 Mrad, appeared to be increased over that of controls. Irradiation of samples under anoxic conditions at 4 Mrad resulted in a decrease in antithiamine activity. The spectra of extracts of irradiated and non-irradiated fish indicated that changes in the spectra of heme proteins resulted from irradiation, but apparently this had no effect on antithiamine activity. (C.H.)

50951 EFFECT OF ISOPROTERENOL ON SUSCEPTIBILITY OF X-IRRADIATED RATS TO EXPERIMENTAL BACTERIAL ENDOCARDITIS. Highman, Benjamin (Armed Forces Inst. of Pathology, Washington, D. C.); Streett, Richard P. Jr.; Byers, Norman T. Res. Commun. Chem. Pathol. Pharmacol.; 3: No. 3, 683-90(May 1972).

Epinephrine was shown to predispose x-irradiated rats to endocarditis. To determine if this effect is nonspecific or due to myocardial damage induced by epinephrine, three groups totaling 97 Osborne-Mendel rats were exposed twice to 400 R and 3 and 4 days later given an i.v. inoculation of Streptococcus mitis. One irradiated and nonirradiated group received 40 mg/kg isoproterenol subcutaneously 24 hrs before each bacterial inoculation to produce focal myocardial necrosis. A second irradiated group received by stomach tube 1.5 ml/kg of 50% carbon tetrachloride (CCl_4) in olive oil 6 hrs before the first inoculation to produce hepatic necrosis without myocardial lesions. The third group received neither compound. At 6 days after inoculation, the incidence of bacterial endocarditis in the nonirradiated and in the isoproterenol, CCl_4, and untreated irradiated groups was 0, 59, 12, and 20%, respectively. The low incidence of endocarditis in the CCl_4 group, despite a high mortality and morbidity, is attributed to lack of myocardial lesions before inoculation. These findings indicate that myocardial damage specifically predisposes irradiated rats to bacterial endocarditis, possibly due to impairment of endocardial circulation by cardiac insufficiency and edema. (auth)

50952 INFLUENCE OF β-MERCAPTOETHYLAMINE ON THE ^{14}C-VALINE INCORPORATION IN THE PROTEIN-SYNTHESIZING SYSTEM OF THE SPLENIC NUCLEI IN RATS. Nikol'skii, A. V.; Blokhina, V. D.; Romantsev, E. F. Farmakol. Toksikol.; 34: 476-8(Jul-Aug 1971). (In Russian).

Experiments conducted on rats demonstrated β-mercaptoethylamine capable of inhibiting protein synthesis in the DNP system. This effect is of great significance in the mechanism of radioprotective action of the agent under discussion. (auth)

50953 EFFECT OF IONIZING RADIATION ON ENZYME ACTIVITY IN THE NEUROGLIA OF THE DEVELOPING RABBIT BRAIN. Wender, M.; Kozik, M.; Owsianowski, M. (Medical Academy, Poznan, Poland). Folia Histochem. Cytochem. (Krakow); 9: No. 3, 299-304(1971).

The activity of acid and alkaline phosphatases, thiamine pyrophosphatase, adenosine triphosphatase, non-specific esterase, acetylcholinesterase, and butyrylthiocholinesterase was examined in the developing neuroglia of the rabbit brain exposed to a single dose of 150 R of x rays on the 18th day of fetal life. The investigation led to the following conclusions: The results of histoenzymatic examinations of the activities of acid and alkaline phosphatases, TPPase, and ATPase in the irradiated animals do not differ perceptibly from those obtained for normal development. The activity of butyrylthiocholinesterase in the myelinated fibers of the animals irradiated in fetal life does not vary from that observed for physiological conditions. On the other hand, n increase in the activity of this enzyme can be recorded in the pr cess of maturation of the interfascicular oligodendroglia. This divergence becomes very distinct as soon as the myelinization process is concluded. The activity of butyrylthiocholinesterase in the interfascicular oligodendroglia does not play any substantial role in the metabolism of the myelin components. (auth)

Invertebrates

Refer also to abstracts 50833 and 50834.

50954 (COO-2001-7) GENETIC EFFECTS OF LOW X-RAY DOSES IN DROSOPHILA. Progress Report, December 1, 1971–November 30, 1972. Abrahamson, Seymour; Meyer, Helen Unger (Wisconsin Univ., Madison). 1972. Contract AT(11-1)-2001. 13p. Dep. NTIS.

Results are reported from experiments concerning the numerical relationship of dose and mutability of immature germ cells (oogonia) of Drosophila at very low x ray doses. Young adult females (P_1) receive 0, 20, 100, 200, and 500 R of 250 kv x rays. Sporadically high doses of 6000 and 3000 R were given to check the potential mutability of the x-chromosome. P_1-females were mated and brooded intensively for 13 days. Progeny from cells in oogonial stage at irradiation time were analyzed for new sex-linked lethals. By testing only one single daughter from each treated P_1-female, clusters of mutations of identical origin were avoided. P_1-females heterozygous for a pre-existing lethal were excluded. (auth)

50955 (N-72-20051) GENETIC IMPLICATIONS OF SPACEFLIGHT. Oster, Irwin I. (Bowling Green State Univ., Ohio). 1971. 14p. NTIS.

Results of experiments using highly specialized strains of the fruit fly, Drosophila melanogaster, are presented. The types of effects on somatic and reproductive cells are tabulated. The results reported suggest that radiation appears to interact with weightlessness to produce a higher mortality, more chromosomal breakage followed by loss or exchange of genetic information, and more sex-linked recessive lethal mutations in actively growing and metabolizing individuals than are produced in those irradiated on earth. (STAR)

50956 (N-72-20053) SOME EFFECTS OF SPACEFLIGHT ON THE FLOUR BEETLE, TRIBOLIUM CONFUSUM. Buchhold, Brenda; Slater, J. V.; Silver, I. L.; Yang, T.; Tobias, C. A. (California Univ., Berkeley). 1971. 17p. NTIS.

Stock cultures of Tribolium confusum Duval pupae were grown at 30 C in whole wheat flour with 2% yeast additive. Age sensitivity studies involving larval and pupal sensitivity to radiation were made. Postflight tests for wing abnormality and genetic mutations were made several months after the Biosatellite 2 flight. The results also indicate that there is internal compensation in animal development for changes in the gravitational field. (STAR)

50957 RADIOSENSITIZING ACTION OF IODOACETATE AND KI ON DEVELOPING SEA URCHIN EGGS. Tarasenko, A. G.; Savvateev, V. I.; Nekrasova, I. V. (Inst. for Biological Evolution, Moscow). Dokl. Akad. Nauk SSSR; 202: No. 6, 1438-40 (21 Feb 1972). (In Russian).

For investigating the radiosensitizing action of iodoacetate and KI on sea urchin eggs, the eggs were x-irradiated while immersed in solutions of iodoacetate and KI (2×10^{-4} M and 2×10^{-3} M). The concentrations used had no observable toxic effect on the cells, nor influence on normal development of similar eggs. The data indicate that a distinct sensitizing effect of iodoacetate and KI on the developing eggs occurred. (K.S.W.)

50958 EFFECTS OF GAMMA RADIATION ON A SPIDER MITE, TETRANYCHUS ARABICUS. 1. IRRADIATION OF EGGS. Elbadry, E. A.; Abe Elaal, M. A. (Ain Shams Univ., Cairo). J. Econ. Entomol.; 65: No. 4, 947-50(15 Aug 1972).

Eggs of the spider mite, Tetranychus arabicus, of two different ages were exposed to gamma rays from cobalt-60, and hatchability depended on age at treatment. Eggs irradiated at an early stage of embryonic development (1 day old) were considerably more susceptible than those exposed at the later stage (four days old). Dosages of 9052 and 70,000 rad prevented egg hatching in one- and four-day-old eggs, respectively. Unfertilized eggs were more sensitive to radiation injury than fertilized eggs. Retardation in embryonic and postembryonic growth was noticeable. Mortality was high in larvae and in nymphs that hatched from irradiated eggs. Many emerged adults were malformed and showed a fusion of tarsal segments. Sublethal doses of 3224 and 14,086 rad significantly reduced fecundity and fertility of adults which emerged from one- and four-day-old irradiated eggs, respectively. Irradiation of four-day-old eggs at 35,000 rad resulted in non-ovipositing females. Adult longevity was affected adversely. Males were more sensitive to radiation damage than females. Dosage of 3224 and 14,086 rad inhibited emergence of males from irradiated one- and four-day-old eggs, respectively. (auth)

50959 COMPETITIVENESS AND BEHAVIOR OF TOBACCO BUDWORMS STERILIZED WITH RESERPINE AND GAMMA IRRADIATION. Guerra, A. A.; Wolfenbarger, D. A.; Hendricks, D. E.; Garcia, R. D.; Raulston, J. R. (Agricultural Research Service, Brownsville, Tex.). J. Econ. Entomol.; 65: No. 4, 966-9(15 Aug 1972).

Female Heliothis virescens sterilized with a combination of substerile doses of reserpine (0.1% wt/v) and gamma irradiation (10 and 15 krad) competed on an equal basis with untreated females for untreated males. The observed percent reduction in hatch of eggs when the ratios of treated to untreated adults was 0:1, 1:1, 4:1, 9:1, and 19:1 was generally comparable to or exceeded the theoretical percentage, especially at the higher dose of irradiation. Collections in light traps showed no differences in the flight potential or mating frequency between untreated moths and moths reared as larvae on diets containing 0.1 reserpine with or without Calco red dye (0.0625% wt/v) and later irradiated as pupae with 7.5 krad. The distribution of reserpine in the test diets was homogenous, based on the observed biological activity of the treated insects. (auth)

50960 SUSCEPTIBILITY OF GAMMA-IRRADIATED AND UNIRRADIATED CODLING MOTHS TO AZINPHOSMETHYL, CARBARYL, AND DDT. Moffitt, H. R.; White, L. D. (Agricultural Research Service, Yakima, Wash.). J. Econ. Entomol.; 65: No. 4, 1008-10(15 Aug 1972).

Adult Laspeyresia pomonella (L.) irradiated with 25 or 40 krad of γ irradiation from a ^{60}Co source, were more tolerant of topical applications of azinphosmethyl, carbaryl, or DDT than were unirradiated moths. The lower dose of irradiation usually resulted in a greater degree of insecticide tolerance than did the larger dose. There was some difference in response between the sexes: females, either irradiated or unirradiated, were more tolerant of azinphosmethyl or carbaryl than were males, but both sexes of unirradiated moths were equally susceptible to DDT. Although the irradiated moths had some tolerance to the insecticides, the degree was probably not great enough to achieve a more favorable ratio of native to sterile moths by the application of any one of these insecticides in orchards being treated by the release of sterile codling moths. (auth)

50961 SEX DIFFERENCES IN THE RADIOSENSITIVITY OF RHYZOPERTHA DOMINICA ADULTS. Singh, Harpal; Liles, J. N. (Univ. of Tennessee, Knoxville). J. Econ. Entomol.; 65: No. 4, 1213(15 Aug 1972).

Sex differences in the survival rate of adult lesser grain borers, Rhyzopertha dominica, were observed at five-day intervals for 30 days following exposure to doses of γ radiation of 5 to 80 kR. All insects, whether male or female, died within 15 days following exposure to 80 kR; at 40, 20, and 10 kR there was no significant difference in the survival of males and females during the first 10 days but the survival of females significantly exceeded that of males over the 30-day period; at doses of 5 kR male survival surpassed that of females during the first 15 days but during the last 15 days female survival increased significantly over that of males. (C.H.)

50962 RADIATION STERILIZATION FOR PEST CONTROL PURPOSE IN AGRICULTURE. Andreev, S. V.; Martens, B. K.; Kablov, V. V. (All-Union Scientific Research Inst. for Plant Cultivation, Leningrad). Isotopenpraxis; 8: No. 2, 68-70(Feb 1972). (In German).

The studies conducted in Russia on pest control in grain products by the use of radiation sterilization are reviewed. (J.S.R.)

Radionuclide Effects (Internal Source)

Refer also to abstract 50435.

Man

Refer also to abstracts 50852, 50854, and 50865.

50963 (KFK-1582) AGE DEPENDENT INGESTION DOSE FACTORS g_G AND g_G' OF ^{131}I. Bayer, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Apr 1972. 47p. (In German). Dep. NTIS (U. S. Sales Only).

The relation of the radiation dose to the thyroid of children of various ages following the ingestion of ^{131}I in milk was determined based on the content of ^{131}I in air. A maximum thyroid dose of 90 mrem/year for children is proposed. (C.H.)

50964 (UCRL-73195(Rev.1)) DOSE TO MAN VIA FOOD-CHAIN TRANSFER RESULTING FROM EXPOSURE TO TRITIATED WATER VAPOR. Anspaugh, L. R.; Koranda, J. J.; Robison, W. L.; Martin, J. R. (California Univ., Livermore. Lawrence Livermore Lab.). Revised 13 Jul 1972. 30p. (CONF-710809-19). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

Efforts to predict the radiation dose to man as a result of food-chain exposure to tritiated water vapor have been severely handicapped by lack of knowledge concerning the behavior of tritium released to ecosystems, and by the lack of predictive models appropriate for tritium. A simple model is presented to predict doses to man resulting from food-chain contamination due to exposure to tritiated water vapor. It incorporates knowledge concerning the experimental behavior of tritiated water which was obtained during radioecology studies related to Project Rulison and controlled exposures at Livermore. The model is specifically directed to the prediction of dose from the release of tritiated water vapor from a point source, but most of the model is applicable to any tritiated water vapor exposure. Dose commitments via inhalation plus absorption and via the ingestion of vegetables, milk, and meat are considered. The model may be entered with a variety of input data; average values of the parameters needed to evaluate the model are provided, but other values more appropriate to a particular situation may be substituted readily. (39 references.) (C.H.)

50965 HAEMOGLOBIN OF ERYTHROCYTE STROMATA IN URANIUM MINERS. Nosek, J.; Pehr, F. Cas. Lek. Cesk.; 110: No. 51, 1185-8(17 Dec 1971). (In Czech).

The determination of hemoglobin in the erythrocyte stromata of uranium miners is described. The content of stromata-bound hemoglobin in uranium miners was greater by 16% than that in the controls. A correlation was found between the increase in hemoglobin content of the erythrocyte stromata and the change in the average rate of in vitro conversion of methemoglobin in erythrocyte suspensions. The amount of stromata-bound hemoglobin as well as the amount of polarographically active sulfhydryl groups in hemolysates decreased with the decreasing rate of in vitro conversion of methemoglobin in erythrocyte suspensions. The maximum increase in the content of stromata-bound hemoglobin was found in uranium miners working underground for 5.5 yrs. (INIS)

Animals

Refer also to abstracts 50918 and 50919.

50966 (EUR–4810(Vol.1), pp 371-88) COMPARATIVE RADIOTOXICITY OF ^{3}H-IUdR AND ^{125}IUdR AFTER INCORPORATION INTO DNA OF CULTURED MAMMALIAN CELLS. Roots, R.; Feinendegen, L. E.; Bond, V. P. (Institut fuer Medizin Kernforschungsanlage, Juelich, Ger. Brookhaven National Lab., Upton, N. Y.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Synchronous and asynchronous populations of L 5178 Y mouse leukemia cells were used to study the relative radiotoxicity of ^{3}H-IUdR and ^{125}IUdR incorporated into DNA during one S-phase or one generation time period. Cell survival was assayed by cloning in soft agar. For a given initial energy deposition (rads/h per nucleus), cell sensitivity was found to be approximately seven times greater for ^{125}IUdR than for ^{3}H-IUdR under our experimental conditions. Proper interpretation of the dose response curves is complicated by heterogeneous labeling from cell to cell within the population, and by differences in dose rate histories. Even with these limitations the ^{125}I toxicity exceeds that of ^{3}H-IUdR on the basis of absorbed dose. (auth)

50967 (EUR–4810(Vol.1), pp 389-98) BIOLOGICAL EFFECTIVENESS OF ^{125}I IN DNA RELATIVE TO ^{3}H AND ^{32}P. Feige, Y.; Gavron, A. (Soreq Nuclear Research Centre, Yavne, Israel).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The toxicity of ^{125}I decaying within the DNA of proliferating cells in vivo was compared with that of ^{3}H in a similar molecular position by Feinendegen et al. They found that for equal activities ^{125}I was about 10 times as effective as ^{3}H. The studies of Krisch et al. on the lethal effects of ^{125}I decay in the DNA of bacteria and bacteriophage showed that ^{125}I decays are approximately 10 times more efficient in killing microorganisms than are ^{32}P decays. An attempt to confirm these results by microdosimetric calculations based on the physical characteristics of the decay schemes involved is presented. The number of emitted electrons per decay seems to be the relevant parameter for inducing radiation effects on the biochemical level, rather than the locally absorbed energy. (auth)

50968 RADIUM-INDUCED EYE MELANOMAS IN DOGS. Taylor, Glenn N.; Dougherty, T. F.; Mays, C. W.; (and others) (Univ. of Utah, Salt Lake City). Radiat. Res.; 51: No. 2, 361-73(Aug 1972).

Approximately 0.071% of an iv injected dose of ^{226}Ra was initially retained in each eye of beagles and principally in the melanin granules of pigmented cells and the rodlike organelles of the tapetum. The retention half-times varied inversely with the injected dose, ranging from 105 days at 9.18 μCi/kg to 619 days 0.0593 μCi/kg. The resulting radiation-induced eye lesions were characterized by loss of pigment at the higher doses and melanosis and intraocular melanoma formation in the lower levels. Most of the eye melanomas arose in the ciliary body and tentatively appeared to be derivatives of the pigment epithelial layer. They occurred below the lowest osteosarcoma induction doses for ^{226}Ra and ^{228}Ra by factors of 3 and 8, respectively. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 50435, 50588, and 50633.

Man

Refer also to abstract 50592.

50969 (BNWL–1651(Pt.2), pp 1-7) INHALATION HAZARDS TO URANIUM MINERS. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The high incidence of lung cancer and other respiratory ailments in uranium miners requires accurate characterization of the radionuclide, elemental, and organic content of the uranium mine air and their correlations to lung exposure. A sensitive air sampler was designed for continuous measurement of the radon daughter concentration as a function of aerosol particle size. (C.H.)

50970 (BNWL–1651(Pt.2), pp 95-7) MECHANISMS OF ENVIRONMENTAL EXPOSURE. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

One of the radionuclides formed by neutron activation in Hanford production reactors and released to the Columbia River in effluent cooling water prior to February, 1971 was ^{65}Zn. This radionuclide has a relatively long radioactive half-life (245 days) and is an isotope of an element utilized in metabolic processes by most shellfish and other aquatic life forms. Consequently, ^{65}Zn is found in fish and shellfish in the Columbia River and in the Pacific Ocean near the mouth of the River. The transfer of ^{65}Zn through various food chains to man has been studied for a number of years. Consumption rates of four seafoods (clam, crab, shrimp, and oysters) were obtained for 250 residents of Rockaway, Oregon, and Ilwaco, Washington, by personal interviews. These consumption rates were used in conjunction with ^{65}Zn concentrations in the seafoods of interest to estimate the ^{65}Zn body burden of each individual. (C.H.)

50971 (BNWL–1651(Pt.2), pp 98) RADIOLOGICAL EVALUATION OF POST MORTEM TISSUE SAMPLES. Nelson, I. C.; Heid, K. R.; Fuqua, P. A.; Mahony, T. D. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

The collection, radioanalysis, and evaluation of tissue samples obtained post-mortem from plant workers and residents in the environs of the Hanford Project are discussed. The significance of this effort lies primarily in developing the capability for assessing the overall long-term effectiveness of engineering safeguards which govern the release of radioactive materials to the Hanford environs. The data are similarly important for assessing the overall impact on occupational workers through correlation of exposure conditions and resulting body burdens. Results of plutonium analyses on tissue samples obtained prior to late 1970 were assembled, analyzed, and reported. (auth)

50972 (FRNC–R–11) PULMONARY RADIOCONTAMINATION. Thieblemont, Pierre (Centre de Recherches du Service de Sante des Armees, Percy (France). Division de Radiobiologie Experimentale). Jun 1971. 126p. (In French). Dep. NTIS (U. S. Sales Only).

Important research on bronco-pulmonary retention, deposition, and cleaning of inhaled radioactive substances was undertaken. The chemical consequences of pulmonary radiocontamination were studied, the importance of medical surveillance, and the pathological consequences being demonstrated. The recommendations formulated by the International Commission of Radiological Protection are reviewed. In addition to envisaging respiratory radiocontamination in peacetime, the consequences of conflicts involving the use of nuclear weapons are considered. (France)

50973 (UCRL–73178(Rev.1)) MOVEMENT OF TRITIUM IN ECOLOGICAL SYSTEMS. Koranda, John J.; Martin, John R. (California Univ., Livermore. Lawrence Livermore Lab.). Revised 13 Jul 1972. 47p. (CONF-710809–18). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

The detection of tritium as a contaminant of the biosphere occurred shortly after the advent of the thermonuclear era and the detonation of the first thermonuclear explosive. Other sources of tritium which may be released to the environment are tritium separation plants, nuclear power reactors, nuclear fuel processing plants, and accelerators. A future source of tritium is the controlled thermonuclear or fusion reactor whose fuel is tritium and deuterium. It seems inevitable that the biosphere will acquire an increasing burden of tritium as the nuclear age unfolds, and that detailed information on its behavior in many kinds of ecological systems will be needed to determine the hazards associated with operations releasing tritium to an uncontrolled environment. It has been calculated that by the year 2000 in the free-world nuclear power economy, the accumulated fission-product inventory of tritium in the biosphere will be 9.6×10^{7} curies. However, it will not be until 1990 that the natural rate of tritium production, at 4 to 8 MCi per annum with a steady state inventory of 70 to 140 MCi, will be exceeded. The capacity of the biosphere for dilution of tritium would seem to be almost infinite. On the other hand, the rapid interaction of tritium with biological and physical systems of an environment may partially counteract this potential dilution if the dynamics of tritium in those systems is such that significant incorporation and retention occurs. When tritium is released into an environment, it moves through the local ecosystem into hydrological compartments until it reaches the oceans. Perhaps potential dilution should not be calculated at the level of the biosphere, but at the ecosystem level where tritium first comes into contact with biological and physical systems in the environment. The effects of an exposure of the ecological system or its major components to tritium as tritiated water are described. In the consideration of the fate of tritiated water releases in an ecological system, the form of the release may be either as liquid or as vapor. Because water changes phases easily and often in ecological systems, the phase of the tritium release may also change its phase after the release in the environment. For example, after tritiated water is deposited on plants and soil, it may be vaporized soon, as evaporation and plant transpiration. A vapor release may be deposited as water if vapor interacts with rain or is cooled. It is necessary to know the behavior of both vapor and liquid releases of tritiated water because either form can constitute the dominant mode of release from an installation and the form of the release will determine the persistence or half-time of the tritiated water in that ecological system. In any terrestrial ecological system, there are three main levels through which water, nutrients, trace elements, and contaminants flow. These are the substratum or the soil; the plants growing in that substratum; and the resident herbivores and carnivores. Man is the resident herbivore/carnivore considered. Soil and plant tritium interrelationships are discussed. (26 references.) (C.H.)

50974 DETERMINING THE RESPIRATORY DOSAGE FROM RaA, RaB, AND RaC INHALED BY THE POPULATION IN HUNGARY. Toth, A. Health Phys.; 23: No. 3, 281-9(Sep 1972).

Determination of short-lived radon decay products found in unventilated living rooms in Hungary is described. Altogether 841 analyses were carried out in 14 different towns and villages. In 92% of the investigations, the rooms had not been aired for at least 8 hr prior to taking the air sample. The building materials making up the walls and the distances of the rooms from ground level were different. The characteristics of the relative frequency distributions of the concentrations can generally be said to have been logarithmic-normal. The arithmetical averages of the Radium A, Radium B, and Radium C concentrations obtained through the 841 measurements were: 3.05, 2.64, and 2.49 pCi/l, respectively. The standard deviations of the individual concentration determinations with reference to the RaA-, RaB- and RaC-concentrations were: ±3.66, ±3.38, and ±3.27 pCi/l. On the basis of these radon daughter product concentrations and of certain other assumptions made, the following weighted average alpha-dose-rates were obtained for the Hungarian population: bronchial epithelium: 800 mrad per annum, while for the whole of the lungs: 120 mrad per annum. (auth)

50975 TREATMENT AND EVALUATION OF A ^{238}Pu NITRATE CONTAMINATED PUNCTURE WOUND. A TWO-YEAR CASE HISTORY. Jolly, L. Jr.; McClearen, H. A.; Poda, G. A.; Walke, W. P. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys.; 23: No. 3, 333-41(Sep 1972).

Plutonium-238 nitrate was accidentally deposited in a puncture wound of the right index finger of an employee at the Savannah River Plant Radiochemical Separations Facility in November 1968. A comprehensive treatment and evaluation program was initiated immediately and has continued for more than 2 yr. Postaccident treatment included immediate use of a venous tourniquet; flushing and decontaminating the wound site; excising tissue; and administering chelating agents (intravenously, orally, and by aerosol inhalation). The plutonium injection and assimilation was assessed by wound monitoring; whole-body counting; and an extensive bioassay program (blood, urine, and feces). The plutonium body burden is estimated to be 31 nCi, but complications were encountered in making this estimate because of the use of chelating agents and the lack of information about the movement of plutonium nitrate from the wound site. (auth)

50976 COMPUTERIZED HELICAL SCANNING TO DETERMINE THE LOCATION OF SPECIFIC NUCLIDES IN THE HUMAN BODY. Anderson, J. I.; Olson, D. G. (Atomic Energy Commission Operations Office, Idaho Falls, Idaho). Health Phys.; 23: No. 3, 325-32 (Sep 1972).

A method was developed to locate and to trace the movement of gamma-emitting nuclides in human subjects by scanning the body helically with a collimated scintillation detector. The counting system was a helical scanner and a 4K analyzer. An IBM 360 computer was used to reduce the counting data. For each scan of the body, as many as 4096 separate measurements were made of the level of activity at positions along the helical path of the detector as it moved around and along the body. The results were in the form of computer-produced isometric and/or isocount contour plots showing the location and relative quantities of the specific nuclides in the different sections of the body. Positions on the surface of the body were plotted as a function of gamma activity and gamma energy. Results are given for 12 scans that were obtained from three different persons. Changes in the distribution of the activity in the body were determined as a function of time by repeated scans of the same individual. The results of the study show that helical scanning can be used to determine the total body distribution of gamma-emitting nuclides in humans. If the helical configuration is used, repeated scans are not necessary in order to cover the surface of the body between the selected limits of the scan. Large quantities of data are rapidly reduced to the final results by a high-speed computer. (auth)

50977 INCIDENTS DURING HANDLING OF UNSEALED RADIOACTIVE MATERIALS. Hausser, R. Zentralbl. Arbeitsmed. Arbeitschutz; 20: No. 5, 144-7(1970). (In German).

Two incidents are reported. An α-contamination of hands of about 5×10^{-6} μCi/cm^2 was observed on three persons during personnel monitoring. An unsealed ^{210}Po preparation (0.5 mCi on Ni sheet) was detected as the origin of this contamination. A further contamination was detected during the examination of a package from a luminous paint company, containing samples of non-radioactive luminous pigments. All parts of the consignment were contaminated by ^{147}Pm. The single steps of the investigation of the incidents, including decontamination procedures, are described. (GF)

50978 INVESTIGATIONS ON THE PENETRATION OF SUPERHEAVY HYDROGEN (TRITIUM) INTO THE HUMAN BODY THROUGH THE SKIN DURING HANDLING OF LUMINOUS PAINTS. Billaudelle, H.; Kaltenhaeuser, A. (Battelle-Institut e. V., Frankfurt am Main). Arbeitsmed. - Sozialmed. - Arbeitshyg.; 6: No. 2, 38-43(1971). (In German).

During handling of tritium luminous paints, gaseous, radioactive compounds will penetrate through the skin and the respiratory tract into the body of the person working with these paints. The total amount of tritium thus incorporated, and the amount penetrated into the body through the skin of the hands, was determined by experiments both with and without a suction box covering the hands and the radioactive substance. The specific activity of the urine was taken as a relative measure indicating the tritium concentration in the body. Experiments carried out under operational conditions revealed that incorporation was reduced by 40%, on the average, for handling with a suction box as the tritium could enter the body only through the skin of the hands but not through the respiratory tract. Hence it is concluded that during handling without a suction box more than half of the tritium is incorporated through the skin of the hands. It therefore is highly recommendable to work either with a suction box, or else to protect the hands with an ointment or with gloves. This, however, has not yet been investigated. (GF)

50979 BIOLOGICAL HALF-LIFE OF ^{137}Cs IN MAN. Cryer, M. A.; Baverstock, K. F. (Medical Research Council, Harwell, Eng.). Health Phys.; 23: No. 3, 394-5(Sep 1972).

In order to investigate the claim that the biological half-life of cesium is dependent on the sex, age, and body mass of the individual, published data on the subject was reviewed. From the work considered, it appeared that differences in biological half-life of ^{137}Cs in males and females could be accounted for by differences in body mass. (UK)

Animals

Refer also to abstracts 50918, 50919, and 50968.

50980 (AEC-tr-7316, pp 220-4) METHOD OF INTRAVITAL DETERMINATION OF SOFT GAMMA EMITTERS (WITH ^{210}Pb AS AN EXAMPLE) IN THE BODIES OF SMALL LABORATORY ANIMALS. Lisachenko, E. P.; Litver, B. Ya.; Shamov, V. P. (Scientific Research Inst. of Radiation Hygiene, Leningrad). Translated from Radiobiologiya; 12: No. 1, 148-51(1972).

A substantial fraction of radiobiological investigations is associated with the necessity of determining the content of soft γ emitters in the bodies of small laboratory animals. The work presents a method of intravital measurements of lead-210 (E_γ = 46.6 keV) using two low-background scintillation detectors with NaI(Tl) crystals with diameter 70 × 60 and 60 × 2 nm. The sensitivity of the method is of the order of 10 nCi of lead-210 per animal (rat) in the case of exposure for 1 min. (tr-auth)

50981 (BNWL-1651(Pt.2), pp 81-2) DOSIMETRY OF RADIONUCLIDES IN MAN. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

Efforts continued toward the development of a method for diagnosing the retention of promethium in the bodies of workers following accidental inhalation of $^{147}Pm_2O_3$. Experiments involving intravenously injected promethium-147 and samarium-145 chlorides in citrate buffer solution in rats disclosed that no gross differences occurred in the metabolism of the two radionuclides in that species. The feasibility of using samarium as a carrier for promethium-143 in inhalation studies in rats was investigated. A computer model of the excretion, tissue distribution, and retention of Pu in man following intravenous injection was developed. (C.H.)

50982 (CONF-720708-8) STATE OF COBALT IN SEA WATER AND ITS UPTAKE BY MARINE ORGANISMS AND SEDI-

MENTS. Lowman, F. G.; Ting, R. Y. (Puerto Rico Nuclear Center, San Juan). 1970. 24p. (SM–158/23). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

The effects of the chemical state of ^{57}Co and ^{58}Co in seawater on the uptake by marine organisms was investigated. Clams (Donax denticutatus) and spiny lobsters (Penulirus argus) were kept in a seawater aquarium to which ^{57}Co cobalamin and ionic ^{58}Co were added and shells and soft parts were analyzed. Results showed the uptake of ^{57}Co cobalamin and ionic ^{58}Co was similar. Uptake studies on marine plankton, crab larvae, and marine pelagic crustacea were inconclusive. It is pointed out that approximately half of the dissolved stable cobalt found in marine estuarine waters occurs as complexes which are not ionic and that, while most of the ^{57}Co, ^{58}Co, and ^{60}Co present in the marine environment was produced by nuclear weapons tests it is expected that the future operation of nuclear power reactors cooled by river waters or seawater will add ^{58}Co and ^{60}Co, mainly in ionic form, to the marine inventory. (auth)

50983 (RLO–2227–T–12–33) SEASONAL CONCENTRATION, TURNOVER, AND MODE OF ACCUMULATION OF ^{32}P BY THE JUVENILE STARRY FLOUNDER PLATICHTHYS STELLATUS (PALLAS) IN THE COLUMBIA RIVER ESTUARY. Bolen, John Joseph (Oregon State Univ., Corvallis). 14 Oct 1971. 142p. Dep. NTIS.

Thesis.

The seasonal concentration, turnover, and mode of accumulation of ^{32}P by the juvenile starry flounder in Alder Slough, a small ecosystem in the Columbia River Estuary, was examined during 1969 and 1970. Levels of ^{32}P and concentrations of total P were measured to permit computation of specific activities (nCi^{32}P/g total P). (auth)

50984 (SRO–708–2) RELATIONSHIPS BETWEEN LEVELS OF RADIOCESIUM IN DOMINANT PLANTS AND ARTHROPODS IN A CONTAMINATED STREAMBED COMMUNITY. Anderson, Gilbert E.; Gentry, John B.; Smith, Michael H. (Savannah River Ecology Lab., Aiken, S. C.). 1972. 17p. Dep. NTIS.

Cesium-137 concentrations in several groups of plants and arthropods were measured on the small islands and floodplain of a stream bed contaminated with radioactive wastes. Mean ^{137}Cs concentrations were significantly higher on the islands than on floodplain areas. There were no consistent trends for increasing or decreasing concentration across trophic levels. However, the degree of linear correlation between ^{137}Cs concentrations in different types of plants and arthropods was significant and makes possible a model to predict ^{137}Cs levels in other components of the system. Predictability was highest between the various arthropod groups and lowest among the different plant types. Between two possible producer–herbivore–predator associations (broomsedge–grasshopper–spider, and broomsedge–leafhopper–spider) radiocesium concentrations ratios differed significantly. (auth)

50985 OYSTER RESEARCH WITH RADIONUCLIDES. A REVIEW OF SELECTED LITERATURE. Nelson, Victor A.; Seymour, Allyn H. (Univ. of Washington, Seattle). Contract AT(45-1)-2225. Proc. Nat. Shellfish. Ass.; 62:89-94(Jun 1972).

Major uses of oysters in radioecological studies discussed here are the determination of the effects of radiation on the larvae of the Pacific oyster, Crassostrea gigas, and the distribution of radionuclides in the environment as indicated by molluscs. Uses of radionuclides in oyster research discussed here are depuration studies using radionuclides; the use of radionuclides as metabolic tracers; determination of filtration and feeding rates, using radionuclide-tagged algae; determination of shell formation and growth rate; radionuclides as a field tag; trace element determination by activation analysis; and genetic studies using radiation-increased mutation rates. (auth)

50986 ^{46}Sc METABOLISM, BINDING TO METALLOPROTEINS IN VIVO AND IN VITRO. Ford-Hutchinson, Anthony W.; Perkins, Deryck J. (St. George's Hospital Medical School, London). Radiat. Res.; 51: No. 2, 244-8(Aug 1972).

Following the injection of rabbits with ^{46}Sc as 1 : 2 citrate complex, the binding of scandium to metalloproteins and erythrocytes was studied. Binding to erythrocytes reached a peak after three days and thereafter declined with the plasma radioactivity level. This peak was not due to binding to haem as no incorporation into isolated haemin was observed. Scandium was shown to be transferred between transferrin and ferritin in vitro although in vivo the binding to ferritin appeared to be negligible compared with some other transition metals. The excretion of ^{46}Sc in bile was studied using polyacrylamide gel electrophoresis. No specific scandium–protein complexes were observed, radioactivity being associated either with the bile pigments, or precipitated at the start of the gels or else associated with the small amount of transferrin naturally excreted in the bile. (auth)

50987 EFFECT OF LACTATION ON THE ABSORPTION OF ^{203}Pb AND ^{47}Ca IN RATS. Kostial, K.; Momcilovic, B. (Zagreb Inst. for Medical Research). Health Phys.; 23: No. 3, 383-4(Sep 1972).

Experiments were carried out on nine lactating female rats, four months old, each with a litter of six to observe their absorption of ^{203}Pb and ^{47}Ca as compared with that of an equal number of virgin rats of the same age. The percentage of each radioactive dose recovered in the whole body and excreta are tabulated. Sources of error are discussed. The absorption of ^{203}Pb and ^{47}Ca in the lactating rats including their litters was about 3.5 times that in the virgin controls though in the case of ^{47}Ca the increase in the former was due almost entirely to the increase in absorption by the litter. It is concluded that the morphological augmentation of the gastrointestinal tract in lactation affects the absorption of Ca and Pb. (UK)

50988 INHALATION STUDIES OF URANIUM TRIOXIDE. Morrow, P. E.; Gibb, F. R.; Beiter, H. D. (Univ. of Rochester, N. Y.). Health Phys.; 23: No. 3, 273-80(Sep 1972).

Earlier injection and inhalation studies with uranium trioxide (UO_3) indicated that the material was more similar to soluble uranyl salts than to the so-called insoluble oxides, U_3O_8 and UO_2, but quantitative data were lacking. This inhalation study of UO_3 (enriched with ^{235}U) in dogs substantiated the earlier studies with the findings that: UO_3 is rapidly removed from the lungs, with most following a 4.7 day biological half time; systemic absorption amounted to more than 20% of the exposure burden; and more than 20% of the excreted uranium was found in the urine. External measurement of the UO_3 levels in the lungs (186 keV gamma) produced an erroneous picture of UO_3 clearance because of appreciable ^{235}U accretion in the extrapulmonary structures of the thorax. The inhalation study was complemented by aerosol and in vitro solubility analyses in order to examine a recently-proposed solubility model for alveolar clearance. The health physics implications of the results are discussed. (auth)

50989 FISSION PRODUCTS: SITES FOR THE ELIMINATION OF ^{137}Cs IN RELATION TO THOSE OF ^{42}K IN THE NEPHRONS OF DOGS. Rama Sastry, B. V.; Spalding, Charles T.; Alt, Ronnie L. (Vanderbilt Univ., Nashville). Contract AT-(40-1)-3066. Toxicol. Appl. Pharmacol.; 22: No. 1, 70-81(1972).

In view of the environmental toxicologic importance of ^{137}Cs and its close physicochemical relationships to potassium, the simultaneous renal clearances of ^{137}Cs and ^{42}K were studied in anesthetized female dogs by free-flow and stop-flow urine techniques during mannitol diuresis. The renal clearance of ^{137}Cs (C_{CS}) was equal to creatinine clearance (C_{CR}). Net secretion of ^{137}Cs could be demonstrated during experimental conditions when the net secretion of ^{42}K did not occur. Both ^{137}Cs and ^{42}K were net reabsorbed in the proximal tubule, and net secreted in the distal tubule. There were no significant differences in their clearance ratios (C_K/C_{CR}, C_{CS}/C_{CR}) in the proximal tubule. There were distinct secretory peaks for both ^{42}K and ^{137}Cs in the distal tubule. The secretory peak of ^{137}Cs was at a site proximal to that of ^{42}K. C_{CS}/C_{CR} was significantly higher than C_K/C_{CR} at the peak. The number of distal tubular stop-flow samples in which net secretion of ^{137}Cs was observed were more numerous than those in which net secretion of ^{42}K was observed. The ^{137}Cs that was secreted contained two components: one component was secreted at the ^{137}Cs peak at which net secretion of ^{42}K did not occur; the second component was secreted at the potassium secretory peak. (auth)

Plants

50990 RADIOACTIVE STRONTIUM AND CESIUM IN CULTIVATED AND ABANDONED FIELD PLOTS. Cline, J. F.; Rickard, W. H. (Battelle-Northwest, Richland, Wash.). Health Phys.; 23: No. 3, 317-24(Sep 1972).

Strontium-90 and ^{137}Cs added to surface soil of small field plots 16 and 8 yr ago respectively were measured in tissues of barley, alfalfa, radishes, and beans. Five years ago these plots were abandoned and allowed to be naturally colonized by the annual weeds, cheatgrass and mustards, characteristic of early secondary plant succession in the semiarid steppe region of southeastern Washington. After 16 yr, ^{90}Sr was still available for plant uptake. The major loss was attributed to physical decay. Less than 2% of the estimated loss could be assigned to plant harvest and cultural practices. Strontium-90 was taken up by plants up to 100 times more effectively than ^{137}Cs. After 8 yr, 70% of the added ^{137}Cs remained in the upper inch of untilled soil. In tilled soil ^{137}Cs was concentrated at the tillage depth of 5 to 6 in. After 16 yr, ^{90}Sr was distributed throughout the upper 10 in. of untilled soil and tended to form an accumulated front 5 to 6 in. deep. In the tilled soil, ^{90}Sr was scattered throughout the upper 10 in. and some had probably moved deeper into the underlying gravel. (auth)

New Tracer Techniques

Refer also to abstracts 50215 and 50858.

50991 (CONF-711115) PROCEEDINGS OF SEMINAR ON THE USE OF STABLE ISOTOPES IN CLINICAL PHARMACOLOGY, UNIV. OF CHICAGO, NOVEMBER 10–11, 1971. Klein, Peter D.; Roth, Lloyd J. (eds.) (Chicago Univ., Ill.). Aug 1972. 296p. Dep. NTIS.

Methods for the production of stable isotopes of carbon, nitrogen, and oxygen are described and the advantages and disadvantages of stable isotopes, especially carbon-13, nitrogen-15, and oxygen-16 for use as tracers in clinical studies are discussed. It is pointed out that the greatest advantage offered by stable isotopes over their radioactive counterparts is the absence of problems associated with radiation. The lack of possible radiation damage to living systems is very important in human studies and especially where clinical biochemistry or pharmacology is being done in children or pregnant women. This lack of radiation hazard makes the synthesis and handling of stable isotope-labeled compounds much simpler. The stability of the compounds is less of a problem since there is no decay or radiolytic decomposition to contend with. In some cases, most notably that of deuterium versus tritium, the smaller mass difference of the stable isotope in relation to the most abundant natural isotope makes for a smaller kinetic isotope effect, a source of confusion in certain experiments. In the case of nitrogen and oxygen, the stable isotopes, ^{15}N and ^{18}O or ^{17}O are without competition since there are no radioactive isotopes of sufficiently long half-life to be useful as labels. Stable isotopes are not without their disadvantages however. The greatest single disadvantage with stable isotopes is the lack of a simple, sensitive, inexpensive isotope specific method of quantitation comparable to liquid scintillation counting. The mass spectrometric technique of mass fragmentography provides a molecule-specific detection method whose sensitivity rivals that of radioisotopes in favorable circumstances but this technique requires more expensive instrumentation and is associated with greater analytical complexity than detection techniques such as liquid scintillation counting. Uses of stable isotopes in pharmacology are primarily as tracer labels for drug distribution and metabolism studies. These isotopes may also be useful to the pharmacologist or biochemist as internal standards for quantitative measurements with mass spectrometry or gas chromatography-mass spectrometry. (C.H.)

50992 (UCLA-12-872) CRITICAL EVALUATION OF ^{43}K AND ^{129}Cs FOR QUANTITATIVE MYOCARDIAL SCANNING. Poe, N. D.; Eber, L. M.; Graham, L. S.; Nikesch, W.; MacDonald, N. S. (California Univ., Los Angeles. School of Medicine). [nd]. Contract AT(04-1)-Gen-12. 21p. Dep. NTIS.

The recent availability of potassium-43 and cesium-129 has revived interest in myocardial scanning. A study was undertaken to compare imaging characteristics of these two ions for the purpose of quantitating myocardial infarction. In over 30 patients studied by intravenous and/or intracoronary injections of cesium-129 and potassium-43, only large abnormalities such as aneurysms could be defined consistently. It is concluded that radiopharmaceuticals with greater myocardial specificity are needed for quantitative measurement of regional myocardial ischemia. (auth)

50993 NUCLEAR ENGINEERING APPLICATIONS IN MEDICAL SCIENCE. Jester, William A. (Pennsylvania State Univ., University Park); Jackson, George L.; Lee, Bong K.; Burkle, Joseph S.; Jarrell, Donald. Isotop. Radiat. Technol.; 9: No. 4, 485-99(1972).

The current status of nuclear medicine is reviewed, the roles that the nuclear engineer and nuclear engineering departments can play in nuclear medicine are suggested, and the specific efforts of The Pennsylvania State University's Nuclear Engineering Department in this field are described. Radioisotopes of medical interest are listed in an appendix. (auth)

50994 ^{99m}Tc-PENICILLAMINE, A NEW CHOLESCINTIGRAPHIC AGENT. Tubis, Manuel; Krishnamurthy, G. T.; Endow, John S.; Blahd, W. H. (Univ. of California, Los Angeles. Univ. of Southern California, Los Angeles). J. Nucl. Med.; 13: No. 8, 652-4(Aug 1972).

A new radiopharmaceutical, ^{99m}Tc-Penicillamine (Tc-Pen), may fill the need for a ^{99m}Tc-labeled agent for cholescintigraphy and may also aid in the differential diagnosis of space-occupying lesions in the liver due to either primary or secondary tumor. This agent may prove helpful in the differential diagnosis of obstructive jaundice and the diagnosis of congenital biliary atresia in the newborn. Tc-Pen is simply and readily prepared and has been shown to be of very low toxicity and to utilize the favorable properties of ^{99m}Tc. The potentialities of this new radiopharmaceutical for cholescintigraphy are very promising. (auth)

50995 RENOGRAM AND DISTRIBUTION OF TRANSIT TIMES. Floyrac, R.; Itti, R.; Planiol, T.; Pourcelot, L. (Centre Hospitalier Regional Bretonneau, Tours, France). Ann. Phys. Biol. Med.; 6: No. 1, 1-16(1972). (In French).

The mathematical formalism developed by Zierler for hemodynamic studies with tracers can be used to derive a formula that permits the distribution of the transit times of labeled molecules through the kidneys to be obtained from the radioisotope renogram. It is not necessary to introduce assumptions about the nature of the flow or mixing processes in the nephrons or the renal pelvis. Clinically, the trace can be used to demonstrate the existence of prolonged transit times that may indicate the degree of impairment of the renal function and the proportion of abnormal nephrons. (France)

50996 METHOD FOR EVALUATING AN EXPERIMENTAL ATHYREOSIS. Schimmelpfennig, K. (Pharmakologisches Institut, Berlin); Kaul, A.; Haberland, U. Acta Endocrinol.; 70: 289-94(1972).

A micro-^{131}I-test is presented which allows an easy separation of completely surgically thyroidectomized experimental animals from animals with aberrant or residual thyroid tissue. The application of the method is easy and not time-consuming: the total time spent on one animal is approximately 3 min. The method is based on the principle that the ^{131}I storage is measured over the cervical region. The application of this method gives the following advantages: When performing studies with proven athyroid rats it is not necessary subsequently to demonstrate athyreosis (histologically, BMR, or PBI). Time-consuming experiments with animals that are not definitely athyroid can be avoided. The additional fractionated radio-iodine resection after surgical thyroidectomy, used by many authors to destroy residual thyroid tissue, becomes superfluous. Such a procedure takes 4 to 8 weeks. The animals may be used after a 5-day-period. This excludes secondary changes like weight loss and distributed development that have to be taken into consideration when using a radio-iodine resection. (Denmark)

50997 SENSITIVE, PRECISE RADIOIMMUNOASSAY OF SERUM INSULIN RELYING ON CHARCOAL SEPARATION OF BOUND AND FREE HORMONE MOIETIES. Albano, J. D. M.; Ekins, R. P.; Maritz, G.; Turner, R. C. Acta Endocrinol.; 70: 487-509(1972).

A radioimmunoassay method for the measurement of plasma insulin is described relying on activated charcoal for the separation of free and bound fractions. The technique illustrates the application of theoretical precepts designed to maximize assay precision in all radioimmunoassay and other saturation assay techniques. In addition, because particular emphasis has been placed on ensuring that, as far as is possible, all incubation mixtures are as similar as possible other than in hormone concentration, non-specific effects appear to have been essentially eliminated. The technique yields a mean normal fasting value of 5.3 μU/ml (range 2-14 μU/ml). Its sensitivity is such that 10 μl samples of serum (or plasma) may be assayed.

MATERIALS

Ceramics and Cermets

Refer also to abstracts 50204, 50490, 50578, 51038, 51062, 51068, 51071, 51079, 51091, 51095, 51147, 51150, 52254, 52265, 52286, 52382, and 52383.

50998 (DP-Report–545) THERMAL CONDUCTIVITY OF ANNULAR BEDS OF COATED FUEL PARTICLES. Project DRAGON. Day, J. H. (Atomic Energy Establishment, Winfrith (England)). May 1968. 56p. Dep. NTIS (U. S. Sales Only).

Measurements have been made of the thermal conductivity of annular beds of loose and bonded coated fuel particles in vacuum, argon, and helium at one atmosphere pressure for mean fuel bed temperatures up to 1200°C. A brief study was also made of the effect on thermal conductivity of variations in gas pressure up to one atmosphere. Experimental results for the packing efficiency of particles in annular containers are also included for both loose and bonded particle beds. (auth)

50999 (DP-Report–557) IRRADIATION EXPERIMENTS ON LOW ENRICHMENT FUEL: LEHPD 1, AND STUDSVIK LOOPS, CHARGE 15. Project DRAGON. Barr, P.; Hagen, H.; Mayr, K.; Soerensen, A.; Svensson, P.; Hankart, L. (Atomic Energy Establishment, Winfrith (England)). Jul 1968. 74p. Dep. NTIS (U. S. Sales Only).

Irradiation experiments are described on low enriched uranium oxide coated particle fuel. Fuel temperatures in the range 1100 to 1470°C were achieved and burn-ups of about 6.5% FIMA resulted. In-vivo gaseous fission product releases as well as solid fission product post-irradiation have been measured. The general performance of the fuel was found to be satisfactory particularly as the fuel was known to have shortcomings before irradiation and also since the irradiation conditions were considerably more severe than those contemplated in a power reactor. (auth)

51000 (DP-Report–560) THERMAL CYCLING OF BONDED FUEL PARTICLES. Project DRAGON. Voice, Eric (Atomic Energy Establishment, Winfrith (England)). Jun 1968. 14p. Dep. NTIS (U. S. Sales Only).

Recent concepts of a nuclear generating system require frequent fluctuations of power, and hence of temperature, in the life of a fuel element. This report demonstrates that severe thermal cycling (in the absence of radiation) has no effect on the mechanical integrity of a Dragon-type bonded fuel body. (auth)

51001 (DP-Report–585) HEAT TRANSFER ASPECTS OF COATED PARTICLE FUEL AND TEST ELEMENTS. Project DRAGON. Bongartz, K. (Atomic Energy Establishment, Winfrith (England)). Dec 1968. 33p. Dep. NTIS (U. S. Sales Only).

Thermodynamic mechanisms which could influence significantly coated particle fuel behavior during irradiation were investigated with special regard to loose beds of coated particles. The radiation contribution to heat transfer in a loose coated particle bed was estimated. For this purpose a computer program was devised and used to calculate the effective thermal conductivity of the bed, the diameter of the particles, and the conductivity of the bed without radiation contribution. Temperature gradients in a coated particle bed were calculated assuming uniform heat dissipation from the particle surface. The radiation contribution to the heat flux in a loose coated particle bed being known, an estimate was made of the heat flux concentration at the surface of a coated particle near the points of contact between two particles or between a particle and the wall of the container. This concentration of heat flux appears likely to cause the temperature gradients in the particles to go up by a considerably amount. A computer program for calculating one-dimensional temperature profiles in fuel test elements has also been established. (auth)

51002 (DP-Report–603(Pt.2)) GRAPHITE IRRADIATION EXPERIMENTS IN H.F.R. PETTEN. PART II. RESULTS (CAPSULES 1 TO 8 INCLUSIVE). Project DRAGON. Blackstone, R.; Graham, L. W.; Voice, E. H.; Everett, M. R. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 135p. Dep. NTIS (U. S. Sales Only).

Results obtained from a series of 8 capsules designed for repeated irradiation of graphite samples in H.F.R. Petten are described. Samples were irradiated at 600, 900, and 1200°C and neutron doses of up to 4×10^{21} n cm^{-2} equivalent Ni dose Dido have been obtained on a wide range of graphites including special fine grain graphites for the Dragon Reactor at Winfrith and graphites of interest for power reactor versions of helium cooled high temperature reactors. The design and operation of the capsule and a description of sample measurement techniques are given in Part I of this report. Graphite creep experiments are described and reported in a separate report, D.P. Report 562. (auth)

51003 (DP-Report–604(Pt.1)) STRESS ANALYSIS IN COATED FUEL PARTICLES. PART I. THEORY AND EXAMPLES. Project DRAGON. Walther, H. (Atomic Energy Establishment, Winfrith (England)). Aug 1968. 37p. Dep. NTIS (U. S. Sales Only).

A theoretical model has been developed for spherical mutlilayer coated fuel particles which is related to their stress history during fabrication and service. Temperature, fast neutron dose, burn-up, and physical properties may be introduced as arbitrary functions of time, so that good adaptability to the practical problems is achieved. Also considered are particular processes such as decoupling and recoupling of signal zones, suggested by particular states of stress and deformation, as well as the process in which a single layer fails and elastic strain energy is released into the rest of the system. Deformation properties such as thermal expansion, unrestrained dimensional changes under irradiation and heat treatment, elasticity, and irradiation and thermal creep are considered, as well as the anisotropy revealed in such properties, and the build-up of fission gas pressure. Mathematical treatment proceeds in successive steps, small enough that the stress dependent deformation properties (elasticity, creep) can be approximated by linear functions of stresses. The stress variation in a step is then obtained by an analytical solution, the accumulative stresses by summation. Practical examples are calculated using data on systems of UO_2 fuel kernels with buffer layers of porous pyrocarbon and "pressure vessels" of high density pyrocarbon either with or without a silicon carbide interlayer. The results indicate two phases during fabrication in which critical stress levels may exist. One in the buffer layer and one in the silicon carbide interlayer, both occur after their deposition when the temperature is raised for depositing the successive high density pyrocarbon layers. Both stress levels could be reduced by reducing differences of the respective deposition temperatures. Further results indicate for all the considered particle types decoupling of the kernel during cooling from deposition to room temperature, and decoupling or failure of the buffer layer at rather low neutron doses. For particle types with a "composite pressure vessel" (with silicon carbide), the results indicate good dimensional stability under irradiation, except at lower doses where volume shrinkage of pyrocarbon is still effective. The lifetime of such particle types is evidently determined at high burn-up by tangential tensions in silicon carbide, increasing with the fission gas pressure, if not at lower doses by tangential tensions in pyrocarbon, where their dimensional changes precompress the silicon carbide. For particle types with a plain carbon pressure vessel, the results indicate dimensional instability under irradiation: shrinkage in a first, and expansion in a second phase. The expansion (accompanied by reduction of the pressure vessel thickness) is caused by creep under the predominant influence of the fission gas pressure. The tangential tension in pyrocarbon thereby levels off to a steady state, so that no evident limit of particle lifetime is recognized, unless the steady state level itself becomes too high. In an example, failure of the silicon carbide interlayer is simulated at a high burn-up. It is recognized that instead of "catastrophic consequences" in form of the failure of further layers, the system remains intact, but behaves further on as a particle with a plain carbon pressure vessel. (auth)

51004 (DP-Report–604(Pt.2)) STRESS ANALYSIS IN COATED FUEL PARTICLES. PART II. COMPUTER PROGRAMME STRESS I. Project DRAGON. Novario, P. G. (Atomic Energy Establishment, Winfrith (England)). Jul 1969. 94p. Dep. NTIS (U. S. Sales Only).

A program is described for the evaluation of the tangential and radial stresses in spherical coated fuel particles. A Fortran IV listing and instructions for the input data compilation are also given. The theoretical model, on which the formalism is based, is described by H. Walther in Part I of DPR 604. (auth)

51005 (DP-Report–615) RESONANCE ABSORPTION IN MATERIALS WITH GRAIN STRUCTURE: EQUIVALENCE RELATION. Project DRAGON. Journet, J. (Atomic Energy Establishment, Winfrith (England)). Dec 1968. 28p. Dep. NTIS (U. S. Sales Only).

It is shown that with a certain number of assumptions it is possible to derive an equivalence relation for a regular array of macroscopic elements containing absorber grains separated by pure moderator. Among these assumptions the most severe seems to be the assumption of high dilution of the compound, which means low volume fraction of the absorber. This assumption is good for grains in a matrix of graphite but is not fulfilled in the case of loose bonded particles. (auth)

51006 (DP-Report–616) SILICON CARBIDE AS A FISSION PRODUCT BARRIER IN NUCLEAR FUELS. Project DRAGON. Voice, E. H. (Atomic Energy Establishment, Winfrith (England)). Dec 1968. 20p. Dep. NTIS (U. S. Sales Only).

Silicon carbide sandwiched between two pyrocarbon layers gives a highly impermeable mechanically stable coating for nuclear fuel microspheres. Computer programs have been evolved by the Dragon Reactor Project for predicting their useful life at high temperatures and radiation doses. Coating takes place from methyltrichlorosilane in fluidized beds. Varying degrees of homogeneity and stoichiometry can be produced, greatly influencing the stability under subsequent high-temperature irradiation in the reactor. (auth)

51007 (EUR–4809) CODE TAFE: NUMERICAL ANALYSIS OF THERMAL PROBLEMS IN THE PRESENCE OF RADIATION AND TEMPERATURE-DEPENDENT THERMAL CONDUCTIVITIES. Donea, J.; Giuliani, S. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1972. 48p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 60,-.

A numerical method of analysis and the associated computer program are presented for the solution of thermal problems in the presence of radiation and temperature-dependent thermal conductivities. The method is based on the finite-element technique. Plane and axisymmetric situations were investigated. A complete description of the input data is included, as well as numerical examples. (auth)

51008 (EUR–4817) VISCOSITY MEASUREMENT OF FUEL SUSPENSION UNDER IRRADIATION BY MEANS OF VISIR-2 MEASURING DEVICE. Schneiders, A. M.; Hollebeck, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1972. 30p. Dep. NTIS (U. S. Sales Only).

Development and construction of VISIR-2 based on the experience with VISIR-1 are described. VISIR-1 and VISIR-2 are viscometers without rotating parts. Through the use of second viscometer the viscosity of a liquid was measured for the first time in a nuclear reactor. The liquid under investigation was a full suspension in water and was tested using the Ispra-1 reactor. The fuel was subjected to a thermal neutron fluence of about 0.9×10^{20} neutrons/cm^2. The experimental results show an increase of the viscosity of the fuel suspension by approximately a factor of 2.5. (auth)

51009 (HEDL-TME–72-80) CHARACTERIZATION OF INTRAGRANULAR POROSITY PRECIPITATED DURING A TREAT TRANSIENT TEST OF PNL 1-7 AFTER PRIOR IRRADIATION IN EBR-II. Bullington, D. C.; Culley, G. E. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 71p. Dep. NTIS.

The unfolded size distribution of intragranular pores that precipitated in mixed oxide following an overpower TREAT test of fuel previously irradiated in EBR-II to approximately 1 atom percent burnup was measured. The average pore spacing was relatively constant over the fuel radius. The bubble volume fraction and mean bubble size increased linearly as the square of the fuel radius and were greatest near the fuel center. There was no observed evidence of pore migration during the transient which last for several seconds. Data on the intragranular pore size distribution indicated that it was log-normal. This observation is consistent with ex-reactor annealing studies of UO_2 by other investigators. Integration of the bubble size distribution indicated that the fuel radius increased 0.73 mils due to fission gas precipitation during the transient. This is equivalent to a uniform isotropic volumetric expansion of 2.7 percent. (auth)

51010 (INR-P–1364) VIBROCOMPACTION OF METALLIC AND CERMETALLIC POWDERS AS FUEL ELEMENT COMPOSITIONS FOR NUCLEAR REACTORS. Wieczorkowski, Mariusz (Institute of Nuclear Research, Warsaw (Poland)). 1971. 11p. (CONF-700540–12). Dep. NTIS (U. S. Sales Only).

From Polish-Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

A vibratory compacting method to produce nuclear fuel and regulation elements, based on metallic and ceramic powders, is discussed. Tests were carried out of vibratory compacting by different methods, considering theoretical principles of the distribution of grains in the compacted mass. A comparison has been made of the problems connected with compacting by electrodynamic, ultrasonic, and pneumatic vibrators. Investigations related to vibratory compacting by pneumatic vibrators were particularly taken into account, as being significantly cheaper than the other vibrators. Experiments on the obtaining of fuel elements by compacting one fraction of UO_2 powder are described. Up to 85 per cent of the theoretical density can be achieved by this method which is a satisfactory figure for many types of fuel elements. (auth)

51011 (IS-T–538) ELASTIC PROPERTIES OF POLYCRYSTALLINE Gd_2O_3. Haglund, John August (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 64p. Dep. NTIS.

Thesis.

A resonant frequency technique was used to determine the effect that temperature and porosity have on the elastic properties of gadolinia, while the temperature dependence of thermal diffusivity was investigated by a flash method. Young's modulus, shear modulus, and Poisson's ratio were studied from 2.48 to 36.78% porosity to yield porosity dependence curves, with the extrapolated 0% porosity values enabling the calculation of the Debye temperature. Selected specimens were chosen to be analyzed from room temperature to 1352°C to determine curves for the temperature dependence of Young's modulus, shear modulus, Poisson's ratio, bulk modulus, and the first (γ) and second (δ) Grueneisen constants. Thermal diffusivity was measured and graphed over the temperature range 151 to 1347°C and the thermal conductivity was calculated from these results. (auth)

51012 (JUL–687-RW) DEVELOPMENT OF COATED FUEL PARTICLES. KFA CONTRIBUTIONS WITHIN THE FRAME OF THE GERMAN HIGH TEMPERATURE REACTOR FUEL DEVELOPMENT PROGRAM. Nickel, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Aug 1970. 40p. Dep. NTIS (U. S. Sales Only).

Results of investigations on coated particles are described. A preview of the future work on coated particles in reference to HTR material development is included. It appears unnecessary to develop new methods for the production of kernels from solutions. The future work must be restricted to the development of the present processes from the laboratory scale to the technical scale. Cost estimates will certainly play an important role for the process to be employed. The problem of the production of kernels with definite porosity is not completely solved and needs further work. An important question is the feasibility of the wet processes for producing kernels from reprocessed irradiated fuels, and their application in connection with a reprocessing cycle. In production of PyC and SiC coatings with definite properties, large fluidized beds do not work satisfactorily. The problem of nonspherical particles is caused by uncontrollable irregularities in the flow of particles in the bed. Fluidized bed model study results indicate that the deviation from the sphericity of the particles could be minimized by the use of special nozzles resulting in different patterns of particle movement inside the fluidized beds. Improved methods of characterization are required as a consequence of the high demands on coated particles. Apart from already discussed properties, others such as density, anisotropy, crystallite size, Young's modulus, tensile strength, and non-crystalline fraction are to be measured. A method to detect the non-crystalline fraction in PyC is at present being developed in the Institut für Reaktorwerkstoffe of KFA. (auth)

51013 (KFK–1492) NOVEL ELECTRICAL PROCEDURE FOR THE COMPRESSION OF TECHNICAL POWDERS. Jacobi, S.; Schneider, R.; Tradowsky, K. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Aug 1971. 3p. (In German). INIS.

A novel compacting method is described by which powder particles are highly accelerated (20,000 g) by means of electrodynamics. Contrary to conventional methods, compacting is realized without application of external pressure. It is possible to produce relatively long rods with constant and high density (about 70% of theoretical density). The method was tested both with oxides (Al_2O_3, UO_2) and metal powders (iron carbonyl, Mo). (INIS)

51014 (LIB/Trans–416) SAFETY CONCEPTS FOR THE NEW RBG UO_2 PRODUCTION PLANT. Pilgenroether, A.; Thomas, W. Translated by P. J. F. Newton (Australian Atomic Energy Commission Research Establishment), from Atomwirt., Atomtech.; 16: 74-7(Feb 1971). 14p. Dep. NTIS (U. S. Sales Only).

An abstract of this article prepared from the original appeared as NSA 25: 45109 (1971). (Australia).

51015 (NAA-SR-Memo–7991) MECHANICAL PROPERTIES OF LiH. PART I. COMPRESSION TESTS. Lundberg, L. B. (Atomics International, Canoga Park, Calif.). 9 Nov 1962. Contract AT-11-1-GEN-8. 9p. Dep. NTIS.

Declassified 4 Nov 1971.

The compressive properties of cold pressed lithium hydride have been measured over the temperature range 150 to 780°F in a dynamic helium atmosphere. The ultimate compressive strength was found to decrease from 14,300 psi at the lower temperature to 2,190 psi at 780°F. Compressive Young's moduli were observed to decrease by an order of magnitude over the temperature range studied. (auth)

51016 (ORNL-TM-3830) PREPARATION OF SELF-SUPPORTED GeO_2–16 PERCENT P_2O_5–8 PERCENT V_2O_5 FILMS BY SPUTTERING. Braski, D. N.; Early, B. F. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 22p. Dep. NTIS.

Radiofrequency (RF) sputtering was successfully used to produce large self-supported $GeO_2-16\%$ $P_2O_5-8\%$ V_2O_5 glass films in the thickness range from 2000 to 3000 Å. The glass films were soluble in water and were seriously degraded by exposure to air of 100% relative humidity, but were not affected by one-week exposures to air with 50 to 80% humidities. Transmission electron microscopy showed that the amorphous glass films were not uniform in composition and/or structure through their thicknesses. Considerable argon gas from the sputtering plasma was entrapped in the glass films during deposition as revealed later by heating the films in the electron microscope. The amount of argon entrapped was greatly reduced by using a reverse RF bias voltage on the substrate and was eliminated entirely by using ion beam sputtering techniques. (auth)

51017 (RCN–167) EXAMINATION OF FAST REACTOR FUEL PINS IRRADIATED IN A SODIUM ENVIRONMENT IN THE HFR SWING-IN FACILITY. Sens, P. F. (Reactor Centrum Nederland, Petten). Mar 1972. 38p. Dep. NTIS (U. S. Sales Only).

Two fast reactor fuel pins were irradiated in a Na environment in the HFR at Petten for a short duration and at a linear power level of 1100 W/cm. The post-irradiation examination of these pins is described. Accidental interaction between UO_2 and an Al_2O_3 isolation pellet occurred, presumably due to flux peaking at the end of the 50% enriched fuel column. Solidification of the molten fuel in the center of the pin caused the formation of a $UO_2-Al_2O_3$ eutectic network between the primary UO_2 dendrites. The absence of Al_2O_3 in the columnar grain region, except at the outer boundary, can qualitatively be explained by a migration mechanism with the steep temperature gradient as driving force. The POREMOVSKI-program was applied to these experiments. The calculated radius of fusion and the calculated porosity distribution were in good agreement with the metallographic observations. Details are given concerning the microscan investigation on the $UO_2-Al_2O_3$ system, carried out in support of the interpretation of the post-irradiation metallography. (auth)

51018 (UCRL-Trans–10637) STUDY OF THE BORON–CARBON–SILICON SYSTEM. Kieffer, R.; Leimer, G.; Ettmayer, P.; Gugel, E. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Ber. Deut. Keram. Ges.; 49: No. 2, 41-6 (1972). 20p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 26: 28550.

51019 (UCRL-Trans–10638) STUDY OF THE BORON–CARBON SYSTEM. Kieffer, R.; Leimer, G.; Ettmayer, P.; Gugel, E. Translated for Univ. of California Lawrence Livermore Lab., from Ber. Deut. Keram. Ges.; 48: No. 9, 385-9(1971). 17p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 26: 7246.

51020 (WHAN-IR–44) DETERMINATION OF FUEL PELLET HOMOGENEITY BY ALPHA-AUTORADIOGRAPHY AND DETERMINATION OF POROSITY, GRAIN STRUCTURE AND SECONDARY PHASE BY CERAMOGRAPHY. Robinson, J. D.; Stranik, D. A.; Stallwood, T. E. (WADCO Corp., Richland, Wash.). Nov 1970. Contract AT(45-1)-2170. 22p. Dep. NTIS.

A method is described for the determination of the homogeneity of UO_2-PuO_2 mixed oxide FFTF-type fuel pellets by α-autoradiography and porosity, grain structure, and secondary phase by ceramography. The Pu distribution is recorded by exposing a film sensitive to α particles for a predetermined length of time to α particles emitted from Pu and/or PuO_2 enriched areas and developing and fixing the resulting images. The grain size, porosity, and secondary phase of a mixed oxide fuel pellet was determined from photomicrographs of an etched pellet. (P.C.H.)

51021 NASA RESEARCH ON REFRACTORY COMPOUNDS. Gangler, J. J. (National Aeronautics and Space Administration, Washington, D. C.). High Temp. - High Pressures; 3: No. 5, 487-502(1971).

The behavior and properties of the refractory carbides, nitrides, and borides are being investigated by NASA as part of its research aimed at developing superior heat resistant materials for aerospace applications. Fundamental studies are being conducted on the electronic and defect structures of the carbides. The results indicate that there is promise for improving the strength and ductility of these materials. The nature of the bonding in carbides and nitrides is also being studied by determining their vaporization and decomposition characteristics. Studies of the zirconium-carbon-oxygen system show that zirconium oxycarbides of different compositions and lattice parameters can be formed between 1500 and 1900°C and are stable below 1500°C. More applied studies show that hot working generally improves the microstructure and therefore the strength of TiC and NbC. Sintering studies on UN indicate that very high densities can be achieved. Hot pressing of cermets of HfN and HfC produces good mechanical properties for high temperature bearing applications. Attempts to improve the impact resistance of boride composites by the addition of a nickel or carbon yarn were not overly successful. The present technology of the refractory compounds suggests that they will be used in aerospace applications in the near future. (auth)

51022 ENTHALPIES OF FORMATION OF Sm_2O_3(MONOCLINIC) AND Sm_2O_3(CUBIC). Baker, F. B.; Fitzgibbon, G. C.; Pavone, D.; (and others) (Los Alamos Scientific Lab., N. Mex.). J. Chem. Thermodyn.; 4: No. 4, 621-36(Jul 1972).

New measurements of the enthalpy of formation of Sm_2O_3 (monoclinic) were made by oxygen-bomb combustion calorimetry and by solution calorimetry. The weighted average value found is ΔH_f^0 (Sm_2O_3, monoclinic, 298.15°K) = $-(435.86 \pm 0.45)$ kcal_{th} mol^{-1}. From the difference in the enthalpies of solution of Sm_2O_3 (monoclinic) and Sm_2O_3 (cubic), the enthalpy of transition is found to be ΔH_{tr}^0 {Sm_2O_3 (cubic) = Sm_2O_3 (monoclinic), 298.15°K} = (0.9 ± 0.6) kcal_{th} mol^{-1} and the enthalpy of formation of Sm_2O_3 (cubic) is ΔH_f^0 (Sm_2O_3, cubic, 298.15°K) = $-(436.76 \pm 0.73)$ kcal_{th} mol^{-1}. (auth)

51023 INTERNAL FRICTION RECOVERY OF CEMENTED CARBIDES. Doi, H.; Fujiwara, Y.; Oosawa, Y. (Mitsubishi Metal Corp., Omiya, Japan). Acta Met.; 20: No. 9, 1123-35 (Sep 1972).

Previous work has shown that internal friction measurements can provide a very sensitive means to study plastic deformation of cemented carbides which in general possess only a limited ductility. Measurements of internal friction, Young's modulus, and other properties of several prestrained cemented carbides have been carried out as a function of isochronal annealing temperature between 25 to 1000°C. Internal friction of the deformed cemented carbides starts to fall at temperatures in excess of 300 ~ 400°C and at 950 ~ 1000°C it recovers to the value corresponding to the undeformed state. Young's modulus largely exhibits a corresponding variation. Analysis of the internal friction recovery in terms of Granato and Lücke theory reveals that it reflects the process of a reduction of the dislocation density in the binder phase. Characteristic features in comparison with the case of recovery of a pure cobalt metal are broadening of the recovery spectrum and shift of the center position to higher temperature side. This suggests that dense distribution of the carbide particles retards recovery of the cemented carbides by acting as effective barriers against annihilation of dislocations. A small peak corresponding to the precipitation of Co_3W appears at 800°C on the recovery curves of amplitude independent component of internal friction for the cemented carbides of comparatively low carbon concentration. Mechanisms of the precipitation are discussed in some detail. (auth)

51024 PRECIPITATION OF HARD MATERIAL LAYERS, ESPECIALLY OF NITRIDES AND CARBONITRIDES OF THE 4a AND 5a GROUPS, ON HARD METAL SURFACE. Kieffer, R.; Fister, D.; Heidler, E. (Institut fuer Chemische Technolgie Anorganischer Stoffe, Vienna). Metall; 26: No. 2, 128-32 (Feb 1972). (In German).

The precipitation of nitrides and carbonitrides of the 4a and 5a groups of the periodic system on hard metal surfaces is described with respect to its application as protection against wear in cutting tools. Procedures and parameters for precipitation are presented. Cohesiveness and resistance against wear were tested extensively in the case of TiN and preliminarily with other nitrides and carbonitrides in lathe experiments. Results show that TiN layers have an excellent protective effect against wear with outstanding cohesiveness. ZrN, HfN, Ti(C,N), (Ti,V)N as well as other nitride-carbide combinations appear promising as protective layers on hard metals for cutting tools. (tr-auth)

51025 DIFFUSION IN THE UC–ZrC SYSTEM. Fedorov, G. B.; Gusev, V. N.; Smirnov, E. A.; Solov'ev, G. I.; Yankulev, S. S. At. Energ. (USSR); 33: No. 1, 584-6(Jul 1972). (In Russian).

Mixtures of powdered carbides of U and Zr were pressed at 50 kg/mm^2 and then sintered in a vacuum furnace at 2200°C for 2 hr to prepare test rods of UC–Zr. X-ray and metallographic examinations showed only one phase present. Diffusion studies were made with ^{235}U, ^{95}Zr, and ^{14}C, by measuring the penetration depths. Proportionally to the extent of alloying UC by ZrC, the level of diffusion mobility of U, Zr, and C atoms was lowered in the carbide system and the activation energy gradually increased (K.S.W.)

51026 NEW OXYGENATED VANADIUM BRONZES OF LITHIUM, RUBIDIUM, AND CESIUM. Fotiev, A. A.; Golovkin, B. G. Zh. Neorg. Khim.; 17: No. 5, 1334-40(May 1972). (In Russian).

The three oxide systems $Me_2O-V_2O_5-V_2O_4$ were investigated wherein Me = Li, Rb, and Cs. Elevated temperatures (400 to 1,200°C), and either vacuum or air were used as variables in and for comparison of the various phases produced, and the products of interaction. Six new compounds were identified and their physicochemical properties were studied. (K.S.W.)

51027 GLASS FORMATION AND PROPERTIES IN THE SYSTEM OF $CuO-TeO_2-V_2O_5$. Dimitriev, Ya. B.; Marinov, M. R.; Ivanova, I. I. (Higher Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 2, 237-40(1972).

A study was made of the combined influence of V_2O_5 and CuO on the vitrification process, and of the properties of glasses in the $CuO-TeO_2-V_2O_5$ system. Glass was not formed in the binary V_2O_5-CuO system, but ternary glasses containing up to 45 wt% CuO were formed. The specific volume resistance was measured and found to depend strongly on the V_2O_5 content, and less strongly on the CuO content. The temperature dependence of the conductance was also studied. The V^{5+}/V^{4+} analyses indicate that CuO takes active part in the electron exchange. The density, softening point, and chemical stability of the glasses were also determined. (D.L.C.)

51028 VAPOR PHASE FORMATION DURING HIGH TEMPERATURE OXIDATION. Davis, Hubert H. Jr.; Graham, Henry C.; Tripp, Walter C. SAMPE Quart.; 3: No. 3, 1-9(Apr 1972).

Three separate types of vaporization mechanisms which limit or destroy the otherwise protective nature of oxide scales are presented. The first mechanism, direct vaporization, occurs when a condensed metal oxide (MO) undergoes simple evaporation to $MO_{(g)}$. The second reaction to be discussed is oxidation/vaporization, in which oxide MO_x reacts with oxygen to form a volatile higher oxide $MO_y (x < y)$. The third mechanism to be considered is reaction/vaporization, in which oxide MO reacts with an additional component of the system, resulting in reaction products which are easily vaporized. The reaction mechanism for each case is discussed in some detail, and a correlation between the effect and significance of these vaporization mechanisms on the overall oxidation behavior of alloys is shown. (auth)

51029 IMPROVED PROCESSING DEVELOPMENTS FOR CARBON/CARBON COMPOSITES. Jones, Walter C.; Studdert, G. Michael (HITCO, Gardena, Calif.). pp 65-80 of Materials '71. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA. (21 Apr 1971). See CONF-710457.

Descriptions are given of the fabrication techniques and processes developed for construction of basic carbon reinforced carbon matrix (carbon/carbon) products including: Pyro-Carb, Carbocore, Hitcarb, and Pyrolarex. Physical, dynamic, and thermal property data are also included. (auth)

51030 OXYGEN PERMEABILITY OF OXIDE ION-CONDUCTING SOLID ELECTROLYTES. Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Phys. Chem. (Leipzig); 249: No. 5-6, 369-75(1972).

Based on model concepts about transportation of matter and charges, oxygen permeability is theoretically studied in oxide-ion-conducting solid electrolytes. Oxygen permeability is proportional to both mean electronic transport number and ionic conductivity. Theoretically derived functions for temperature and pressure of permeability agree with experimental results reported in the literature. Permeability values permit the deduction of electronic conductivity. In particular, the parameter for defect electron conductivity can be derived from the pressure dependency of permeability. The permeability as function of oxygen pressure on the reference electrode is approximately determined for the oxygen concentration chain, $Na,Na_2O/ThO_2-Y_2O_3$/reference electrode. In the range of practically pure ion conductivity, the permeability is almost independent of oxygen pressure in the reference system. (tr-auth)

51031 SYSTEMS OF NIOBIUM MONOCARBIDE WITH TRANSITION METALS. Guha, J. P.; Kolar, D. (Univ., Ljubljana, Yugoslavia). J. Less-Common Metals; 29: 33-40 (1972).

Phase equilibrium relationships in the pseudobinary systems of niobium monocarbide with iron, chromium, nickel, and cobalt have been investigated by metallographic, electron microprobe and x-ray diffraction techniques. Alloys of variable compositions were arc-melted in an argon atmosphere using non-consumable electrodes and were subsequently annealed at predetermined temperatures, cooled, and subjected to various examinations for phase identification. NbC was found to form simple binary eutectics with the respective metals, with partial solid solubility at both ends of the systems. Eutectic compositions and melting points have been determined and phase diagrams indicating solidus and liquidus temperatures and the extent of solid solubility for each system are presented. (auth)

51032 PHASE RELATIONS IN THE SYSTEM $ZnO-Nb_2O_5-SiO_2$. Dayal, R. R. (Dept. of Energy, Mines, and Resources, Ottawa). J. Less-Common Metals; 29: 1-10(1972).

Phase relations in the ternary system $ZnO-Nb_2O_5-SiO_2$ have been determined at liquidus and sub-solidus temperatures. The following compounds have been encountered as primary phases: ZnO, $3ZnO \cdot Nb_2O_5$, α-$ZnO \cdot Nb_2O_5$, β-$ZnO \cdot Nb_2O_5$, $2ZnO \cdot 17Nb_2O_5$, H–Nb_2O_5, silica (either as tridymite or as cristobalite), and α-$2ZNO \cdot SiO_2$. No ternary phase has been encountered in this system. Five ternary invariant points have been located, four of which are eutectics, the remaining one being a peritectic. Sub-solidus compatibility relationships have also been determined. This ternary system was studied using hot-stage microscopy, quenching, and x-ray diffraction techniques. (auth)

51033 PHASE RATIOS IN La_2O_3-CaO AND Ca_2O_3-CaO SYSTEMS. Lopato, L. M.; Lugin, L. I.; Gerasimyuk, G. I.; Shevchenko, A. V. (Inst. of Problems of Materials, Kiev). Ukr. Khim. Zh.; 38: No. 2, 143-6(Feb 1972). (In Russian).

Phase composition diagrams were constructed for the two binary systems La_2O_3-CaO and Ce_2O_3-CaO in the interval 1,500 to 2,350°C using annealing, quenching, and differential thermal analysis methods. In the Ce_2O_3-CaO system samples with ratios 4 : 1, 2 : 1, 1 : 1, 2 : 3, and 1 : 2 were studied by x-ray diffraction. No new phases were detected in the systems under study. The influence of additions of CaO on the character of change in the temperature of polymorphic conversions of solid solutions on the bases of H- and X-form of La_2O_3 was also investigated. (tr-auth)

51034 NUCLEAR REACTOR FUEL COMPOSITION. Hill, Howard W.; Kaznoff, Alexis I.; Marlowe, Mickey O. (to General Electric Co.). U. S. Patent 3,679,596. 25 Jul 1972. Filed 30 Aug 1968.

The viscosity or creep resistance of oxide-type reactor fuels may be minimized by the addition of low viscosity materials which segregate to the fuel grain boundaries during reactor heat-up and operation. This minimizes the stress applied to the cladding due to mechanical interaction of the fuel and the clad during the reactor operation. Suitable materials include glass formers which may form glasses with the nuclear fuel material. The low viscosity material segregates to the fuel material grain boundaries resulting in a marked increase in the creep rate resulting from less restrained grain boundary sliding. (Official Gazette)

51035 PRODUCTION AND PROPERTIES OF VANADIUM(IV) HYDROXIDE. Golub, A. M.; Tishchenko, A. F.; Kalinichenko, A. M.; Kononenko, I. S. (Kiev State Univ. Kirov State Teachers Inst., USSR). Ukr. Khim. Zh.; 38: No. 2, 115-18(Feb 1972). (In Russian).

A method was developed for obtaining high purity V(IV) hydroxide. The water content in the compound was not constant and varied between 2.5 to 4.0 moles/mole VO_2. A thermogravimetric analysis and spectroscopy study showed that freshly precipitated vanadium(IV) hydroxide corresponded to the formula $V(OH)_4$. The solubility of the product at 20°C was 1.5×10^{-25}. Heating or prolonged storage of $V(OH)_4$ resulted in gradual loss of H_2O with the formation of $VO(OH)_2$, $V_2O_3(OH)_2$, and finally VO_2. (tr-auth)

51036 METHOD OF PREPARING SPHERICAL PARTICLES. Fauvart, Francois; Couston, Jack (to Societe de Fabrication d'Elements Catalytiques). French Patent 2,082,224. 12 Oct 1971. Filed 6 Mar 1970. (In French).

A method of preparing spherical particles intended for the manufacture of sintered spherical granules is described. The method is of particular interest for the preparation of spherical particles from oxide powders of fissile or fertile elements (in particular U, Pu, or Th or a mixture of these elements) and has applications in the manufacture of nuclear fuels in the form of sintered ceramic granules. (France)

51037 THERMODYNAMIC PROPERTIES OF NON-STOICHIOMETRIC UO_2–ThO_2 SOLID SOLUTION BY ELECTRO-MOTIVE FORCE MEASUREMENTS. Tanaka, Hiroshi; Kimura, Etsuji; Yamaguchi, Akio; Moriyama, Joichiro (Kyoto Univ.). J. Jap. Inst. Metals; 36: No. 7, 633-7(Jul 1972). (In Japanese).

The thermodynamic properties of UO_2-ThO_2 solid solution of compositions $(U_yTh_{1-y})O_{2+x}$ with y values of 0.295 to 0.048 and x values below 0.029 were determined by emf measurements. The oxygen concentration cells were of the type $Pt/air/ZrO_2(+CaO)/(U_yTh_{1-y})O_{2+x}/Pt$ or $Pt/Ni, NiO/ZrO_2(+CaO)/(U_yTh_{1-y})O_{2+x}/Pt$ and operated in the temperature range 900 to 1050°C. From the emf values and these temperature dependences, partial molar free energies, enthalpies and entropies of solution of oxygen in the solid solutions were calculated. Between these partial molar quantities and the mean valence of U ion in the solid solutions, there exist correlations which are nearly independent of the values of y. These results suggest that the non-stoichiometry of UO_2-ThO_2 solid solution is similar to that of UO_{2+x}. (auth)

Metals and Alloys

51038 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Juli 1972. Band 6, Heft 7. 175 Referate (Register-Nr.1951-2259), 63 Referate (Register-Nr.487T-549T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. July 1972. Vol. 6, No. 7. 175 Abstracts (Register No. 1951-2259), 63 Abstracts (Register No. 487T-549T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H (1972). 96p. (In German and English).

Corrosion and Erosion

Refer also to abstracts 50439, 51161, 52414, and 52579.

51039 (BARC/I–137) SOME ASPECTS OF OXIDATION OF ZIRCONIUM AND ZIRCALOY-2 IN OXYGEN BETWEEN 450 TO 750°C. Gadiyar, H. S.; Phadnis, S. V.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 26p. INIS.

Kinetic curves of oxidation of crystal bar zirconium were analyzed in the temperature range 450 to 750°C in oxygen at a pressure 100 torr, using electronic thermogravimetric balance. A near linear oxidation behavior was observed during the initial 5 to 10 minutes of oxidation, followed by a parabolic film growth. This initial rapid growth was attributed to high stresses in the oxide. The parabolic growth rate was explained on the basis of diffusion through the thickening oxide by anion vacancy mechanism. Cracking of the oxide film at oxide/oxidant interface occurred at temperatures 700 to 750°C. Activation energy for the rate-controlling mechanism of the parabolic rate growth was observed to be 34.1 ± 3 kcal/mole in the temperature range 450 to 600°C. A comparison of the oxidation rates of crystal bar Zr, Kroll Zr, and Zircaloy-2 at 450, 600, and 750°C was included in the study. Kroll Zr showed slightly higher oxidation rates compared to purer crystal bar Zr, while rates on Zircaloy-2 were higher than both. These variations are discussed on the basis of the presence of impurities or alloying additions in zirconium. Estimates of oxygen solubility in the metal between 600 to 750°C showed that the correction factor will not have much influence on the oxidation kinetics. (INIS)

51040 (BARC/I–142) LIQUID METAL COOLANT: SODIUM. Kirthi, K. N. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 62p. INIS.

The advantages and disadvantages of using sodium and its alloys as reactor coolants are discussed. Various problems resulting from the high chemical activity of sodium, especially with water and air, are discussed. Special equipment developed to pump, measure the hydraulic characteristics and to maintain the purity of the liquid metal is described. The compatibility of various materials, particularly the corrosion characteristics of a few container materials such as, niobium, vanadium, stainless steel, and zirconium are reported. Mechanical damage due to the vigorous chemical reactions resulting from the leakage between the liquid metal and water is noted. Protective measures, such as, preventing contact with the leak and removing the leak are summarized. Sodium-fire extinguishers in different forms as solid, liquid, and gaseous materials are mentioned. Procedures for fighting sodium fires are outlined. Recleaning of sodium is defined as the removal of undrained sodium film which stems from the chemical activity of the metal. The methods, such as, alcohol cleaning and steam cleaning are briefly described. The methods of disposal of alkali metals are enumerated. (INIS)

51041 (KFK–1574) SODIUM CORROSION EXPERIMENTS ON STEEL X10 CrNiMoTi 15 15 (WERKSTOFF NO. 1.4970). Borgstedt, Hans Ulrich; Drechsler, Guenther; Frees, Guenter; Marin, Antonio; Schneider, Helga (Kernforschungszentrum, Karlsruhe (West Germany)). Mar 1972. 28p. (In German). Dep. NTIS (U. S. Sales Only).

Sheet specimens of the stainless steel (Werkstoff-Nr. 1.4970) were exposed 5200 hours to flowing sodium at 0.5 m/s and 600 and 550°C. The oxygen content of the sodium was about 5 wt-ppM. The specimens suffered weight losses, which, in grams, correspond to a loss of thickness of 0.45×10^{-6} cm/m^2 at 600°C and 0.22×10^{-6} cm/m^2 at 550°C. The corrosion rates decreased with the downstream length in the test section. The surface areas up to a depth of 10 μm showed changes of the composition, mainly in the concentrations of chromium and manganese. The carbon content of the material did not underlie any change under the test conditions. The concentration of boron, however, was decreased from an initial value of about 80 ppM to values of about 20 ppM. (auth)

51042 (RD/B/N–2277) ELECTRON PROBE MICROANALYSIS OF CERTAIN METALLIC SPECIMENS EXPOSED IN FUEL ELEMENT ASSEMBLIES OF THE DRAGON REACTOR. Pearce, R. J.; Sparry, R. P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Apr 1972. 18p. (RPC/CM/P–(72)35). Dep. NTIS (U. S. Sales Only).

An electron probe microanalytical examination was carried out on specimens which were exposed in the Dragon reactor at temperatures above ~750°C for periods of either 256 or 493 days. It was shown that oxidation of the alloys Nimonic 75, Nimonic P.E.16, Inconel 800, Corronel 230 and M313 by impurities in the Dragon reactor coolant resulted in a surface oxide scale consisting in every instance of a Cr rich layer with some enrichment of Ti and Mn. Although, generally, enrichments of Ni or Fe in the oxide were not observed, with the Ni base alloy Corronel 230 a Ni rich outer oxide had formed. In all the alloys examined internal oxidation occurred, the oxide forming preferentially from Al segregating at the grain boundaries. This occurred even with only ~0.1 wt % Al in the base alloy. With increasing Al content (up to ~1.2%) there was a tendency to form an apparently continuous surface layer of Al_2O_3 underneath the main oxide layer. (auth)

51043 DISSOLUTION OF Ti–6Al–5V AT CATHODIC POTENTIALS IN 5N HCl. Owen, E. L. (Pennsylvania State Univ., University Park); May, R. C.; Beck, F. H.; Fontana, M. G. Corrosion; 28: No. 8, 292-5(Aug 1972).

Localized dissolution, which was observed on polished surfaces of Ti–6Al–4V during exposure to 5N HCl at cathodic potentials, is explained on the basis of the uneven growth of a surface hydride layer. The possible relation of this behavior to the initiation of stress corrosion cracks is also discussed. (auth)

51044 CORROSION FAILURE OF HARD ALLOYS UNDER CONTACT LOADING. Zhilin, V. A. Fiz.-Khim. Mekh. Mater.; 8: No. 1, 56-8(1972). (In Russian).

Peculiarities of corrosion breakdown of tungsten–cobalt alloys were studied at room temperature in liquid media which contained sulfur compounds, and the effect of contact stresses on corrosion were noted. Corrosion foci were photographically recorded near the imprint of a diamond pyramid or a corundum punch. Corrosion damage of solid alloy electrically heated to 400°C while immersed in a sulfur emulsion for 20 min was also studied. (K.S.W.)

51045 CHARACTERIZATION AND DETERMINATION OF EROSION RESISTANCE. Symposium Presented at the Seventy-Second Annual Meeting, Atlantic City, N. J., June 22–27, 1969. ASTM Special Technical Publication 474. Philadelphia; American Society for Testing and Materials (1970). 440p. $28.75. (ASTM-STP-474; CONF-690667).

Sixteen articles are included; a separate abstract was prepared for each of four. The remaining 12 articles contain information on: cavitation and impact erosion–concepts, correlations, controversies; environmentally controlled cavitation tests; cavitation damage mechanism and its correlation to physical properties of material; vibratory tests in water on the combined action of cavitation and corrosion; cavitation erosion of a ship model propeller; toward quantitative prediction of liquid impact erosion; a statistically verified model for correlating volume loss due to cavitation of liquid impingement; erosion rate–velocity dependence for materials at supersonic speeds; rain and sand erosion, phenomena of material destruction caused by repeated loads; hydrodynamic model of correlation of metal removal rates from repetitive drop impact; analogy between erosion damage and pitting of machine component surfaces; and cavitation damage resistance and adhesion of polymeric overlay materials. (P.C.H.)

For abstracts of individual papers see: 51046–51049.

51046 EFFECT OF TEMPERATURE AND PRESSURE ON CAVITATION DAMAGE IN SODIUM. Young, S. G.; Johnston, J. R. (Lewis Research Center, Cleveland). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 474, 67-102(1970).

From Characterization and determination of erosion resistance conference; Atlantic City, NJ. (22 Jun 1969). See ASTM-STP—474; CONF-690667.

Three materials with widely different mechanical properties, L-605, Stellite 6B, and AISI 316 stainless steel were subjected to accelerated cavitation damage in sodium at 800°F (427°C). L-605 was tested also at 400°F (204°C) and 1200°F (649°C). A magnetostrictive vibratory apparatus was used. Argon was introduced over the liquid sodium to maintain pressures ranging from 1 to 4 atm (1 to 4×10^5 N/m^2). Cavitation damage was determined by volume loss measurements, and metallographic studies were made. It was found that increasing pressure significantly increased cavitation damage to all materials at all temperatures tested. When the volume-loss-rate data were normalized to consider only the heavily damaged area of the specimens, the average volume loss rate increased as a power function of pressure (at pressures above approximately 2 atm (2×10^6 N/m^2)). This result of increasing damage with increasing pressure implies that, in fluid systems where cavitation occurs in high pressure regions, damage to components may be much greater than would be expected normally from cavitation tests conducted at atmospheric pressure. L-605, the one material tested at all three temperatures and all four pressures, exhibited greater damage at 800°F (427°C) than at 400°F (204°C), or 1200°F (649°C) at all pressures. At 800°F (427°C) the single temperature at which all materials were tested over the entire range of pressures, the relative ranking of the materials with respect to resistance to cavitation damage was the same regardless of pressure. In order of increasing damage, it was Stellite 6B, L-605, and AISI 316 stainless steel. This result, together with the fact that the damage rate increased with increasing pressure, suggests that laboratory cavitation damage testing can be greatly accelerated by conducting such tests at higher pressures. Metallographic examination of axially sectioned specimens of all the materials tested at 800°F (427°C) revealed severe undercutting of the surface and transgranular cracking. Surface deformation was indicated by the appearance of slip bands in all materials after testing at 800°F (427°C). Stellite 6B showed extensive cracking of carbides beneath the surface, and L-605 exhibited some bending of twins near the surface. (auth)

51047 COMPARISON OF EROSION RESISTANCE OF STANDARD STEAM TURBINE BLADE AND SHIELD MATERIALS ON FOUR TEST RIGS. Elliott, D. E. (Central Electricity Generating Board, Berkeley, Eng.); Marriott, J. B.; Smith, A. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 474, 127-61(1970).

From Characterization and determination of erosion resistance conference; Atlantic City, NJ. (22 Jun 1969). See ASTM-STP—474; CONF-690667.

To obtain a better understanding of the physical processes involved in erosion and permit a wider range of turbine erosion shield materials to be investigated, an attempt has been made to correlate the erosion behavior of three standard materials (FV 566 blade steel, high-speed tool steel, and wrought Stellite 6B) on four different test rigs over an impact velocity range from 1000 to 2000 ft/s. The four rigs were the Central Electricity Generating Board (CEGB) high-speed erosion machine (HSEM), the Napier rig at Marchwood, and the rigs at English Electric and C. A. Parsons. All four rigs list the tertiary erosion rates (assessed in the tertiary zone where rates approach a steady-state value) of the three materials in the same order of merit for any given speed: the FV 566 highest, followed by the high-speed tool steel, and then the Stellite 6B. Physical differences between the four rigs, principally in the condition of impacting water (that is, size of droplets, etc.), make cross comparisons of erosion resistance difficult. If the relative erosion rate (expressed as a fraction of the maximum erosion rate) is plotted against the relative water quantity (expressed as a ratio of the quantity of water required to achieve maximum erosion), all four sets of test results show remarkably similar characteristics, with a tertiary rate averaging a quarter of the maximum. A simple multiplying factor is not however sufficient to predict tertiary erosion rates in one machine from those in another, principally because the frequency and duration of the impact stress is coupled to the size of the droplets. Tertiary erosion rates taken from the C. A. Parsons (CAP) and English electric (EEC) rigs follow an exponential relationship of the form $(dM/dW)_3 = K_2e^{aV}$ where M is the erosion weight loss, W is the mass of impacting water, V is the impact velocity, and a and K_2 are constants. The value of a lies between 0.0026 and 0.004 for the three materials tested, and an average value of 0.003 would suggest that, under similar conditions, the erosion shields of a 160-in.-tip-diameter turbine are likely to have a terminal erosion rate 2.6 times that of the shields in a 136-in.-tip-diameter turbine. Conditions, however, are unlikely to be the same, as the machine with the larger tip diameter could be expected to reduce the size of the impacting droplets which could more than offset the rise in impact velocity. A supplementary program conducted on the HSEM has demonstrated that droplet size plays an important part in the erosion process, conditioning not only the duration of the incubation period but also the maximum and tertiary erosion rates. The power relationship $M = W (V - V_c)^n$ (where V_c is the critical velocity below which no erosion would be expected to take place and n a constant) successfully correlates the HSEM results for 640-μm Sauter mean diameter (SMD) droplets over the complete test range, but additional factors such as the condition of the surface will have to be considered before the correlation can be extended to cover smaller droplets. (auth)

51048 SOME OBSERVATIONS ON EROSION BY CAVITATION AND IMPINGEMENT. Gould, G. C. (General Electric Co., Schenectady, N. Y.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 474, 182-211(1970).

From Characterization and determination of erosion resistance conference; Atlantic City, NJ. (22 Jun 1969). See ASTM-STP—474; CONF-690667.

The selection of cavitation induced by ultrasonic vibration as a test for erosion resistance of metallic materials is discussed. The resistance of many metallic materials was measured, and the results are reported. In addition, the influence of vibration amplitude and material properties is discussed, and, further, electron micrography was applied to study the early stages of erosion. (auth)

51049 EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS ON LIQUID IMPACT EROSION. Thiruvengadam, A. (Catholic Univ. of America, Washington, D. C.); Rudy, S. L.; Gunasekaran, M. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 474, 249-87(1970).

From Characterization and determination of erosion resistance conference; Atlantic City, NJ. (22 Jun 1969). See ASTM-STP—474; CONF-690667.

Experimental and analytical research on erosion of 1100-0 aluminum, 316 stainless steel, commercially pure annealed nickel, and 6Al—4V—Ti-base (annealed) is summarized. The erosion was caused by the multiple impacts of a water jet in a rotating disk facility. The relationship between the velocity of impact and the number of impacts at which visible indentations were observed was compared with the high-frequency fatigue strength of these materials. The experimentally observed rates of erosion were compared with a recently developed theory of erosion. The fatigue life distribution curves also are included. The peak rate of erosion varied approximately as the fifth power of the velocity, whereas the time at which the peak rate was observed varied as the one-fifth power. The cavitation erosion strength and liquid impact erosion strengths of these materials also were compared. (auth)

51050 OXIDATION OF METAL FILMS BY NITROUS OXIDE. Isa, S. A.; Saleh, J. M. (Univ. of Baghdad, Iraq). J. Phys. Chem.; 76: No. 18, 2530-5(31 Aug 1972).

The oxidation, by N_2O, of evaporated films of Fe, Ni, W, Pd, and Pb was investigated in the temperature range −78 to 250°C. Rapid dissociative chemisorption, which was accompanied by N_2 evolution, occurred on the first four metals at −78°C. The completion of the surface layer on Fe film at −78°C was followed by the formation of bulk oxide. The oxidation of Fe and Ni films by N_2O gas became extensive above 30°C, but the oxidation of W film was slow and far less extensive than of the former two metals. The oxidation of Pd film was confined exclusively to the surface phase and the incorporation reaction became extremely slow even at temperatures as high as 200°C. Pb film, on the other hand, did not take up N_2O irreversibly at any temperature in the range −78 to 250°C. Both the activation energy (E_x) and the preexponential factor (A_x) increased as the extent of the oxidation (X) of each of the Fe, Ni, W, and Pd films increased, so that the experimental rate remained constant; a marked compensation effect existed for the oxidation processes. The effect was likely to arise from energetically heterogeneous reacting sites. The slow step of the oxidation process was assumed to be the dissociative chemisorption of N_2O. The deposition of a Pb film on a film of Fe caused a substantial decrease in the surface area of the latter film. The behavior of the resulting Pb—Fe film toward N_2O in the temperature range −78 to 100°C was very similar to that of the Pb film; reaction occurred only at $T \geq 100$°C and was associated with high values of both the energy of activation and the preexponential factor compared with those for the Fe film. (auth)

Preparation and Fabrication

Refer also to abstracts 50563 and 50771.

51051 (AD–736484) DEVELOPMENT OF POROUS BERYLLIUM. Final Technical Report, May 15, 1969–September 30, 1971. Rosenwasser, Stuart N.; Goddard, David M.; Hovan, Michael J. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Jan 1972. Contract F33615-69-C-1606. 120p. (MDC-G–2744; AFML-TR–71-241). NTIS.

Processing procedures and parameters were developed for the fabrication of uniform controlled permeability porous beryllium billets by cold isostatic pressing and vacuum sintering of fractionated commercial, attritioned powder. Optimized parameters for the production of $1\frac{1}{2}$-in.–diameter billets in the permeability range of 1×10^{-11} in.^{2} to 1×10^{-12} in.^{2} and 3-in.–diameter billets in the permeability range of 5×10^{-10} in.^{2} to 5×10^{-12} in.^{2} were derived by an iterative experimental procedure. (auth) (NTIS)

51052 (AE–457) APPLICATIONS OF MAGNETOHYDRODYNAMICS IN THE METAL INDUSTRY. Robinson, T.; Braun, J.; Linder, S. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jul 1972. 42p. Dep. NTIS (U. S. Sales Only).

After an explanatory introduction, a description of the part which has been and is being played by applications of magnetohydrodynamics in the metal industry is given. Reasons why pertinent MHD research should be intensified are also discussed. (auth)

51053 (COO–1198-895) ELECTRON OPACITY MEASUREMENTS APPLIED TO FILM GROWTH KINETICS. Zahavi, J.; Metzger, M. (Illinois Univ., Urbana). [nd]. 2p. (CONF-720815–1). Dep. NTIS.

From thirteenth annual meeting of the Electron Microscopy Society of America; Los Angeles, CA. (28 Aug 1972).

The growth of anodic films on Al was studied by electron opacity $(-\ln(1 - I_{AB}/I_0))$ measurements using a current-measuring specimen holder in an HU-11A microscope at 100 kV. The electron opacity technique is shown to detect changes in film formation efficiency from chloride in electrolyte, surface preparation, and current density, even when no change is apparent in film structure or electrochemical behavior. (D.L.C.)

51054 (CTC–50) FREEZCAN: A TWO-DIMENSIONAL MODEL OF TIME-DEPENDENT TEMPERATURE DISTRIBUTIONS IN A CASTING PROCESS. Thach, N. R.; Browell, R. W. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 16 Aug 1972. Contract W-7405-eng-26. 93p. Dep. NTIS.

A simple mathematical model of a metal alloy casting process was developed in the form of a describing difference equation with related boundary and initial conditions and incorporated in a FORTRAN IV computer program. This computer program—given mold geometry, mold properties, alloy properties, and initial conditions—calculates time-dependent temperature distributions of the mold and melt and the time-dependent location of the liquid-solid interface in the melt. The ability of the program to accurately model the casting system was verified experimentally. The location and general shape of the concentration of vacancies in the actual casting are identical to the model-predicted location of the solid-liquid interface at a point in time when 90% of the melt is solidified. This seemed reasonable since there is about a 7 to 10% volume shrinkage between pour temperature and room temperature. (auth)

51055 (NMI–7003) DEVELOPMENT AND FABRICATION OF ALUMINUM-CLAD THORIUM TUBES. Final Report, June 1954–March 1956. Roll, I. B. (Nuclear Metals, Inc., Concord, Mass.). 31 Jan 1961. Contract AT(30-1)-1565. 112p. Dep. NTIS.
Declassified 25 Oct 1971.

A process was developed for coextruding $1\frac{1}{8}$ inch by 2-inch aluminum-clad thorium tubes with integral end closures on $12\frac{1}{2}$ foot long cores. The process appears capable of producing tubes with strong bonds, sound end closures, and satisfactory dimensions. Successful coextrusion of aluminum-clad thorium tubes requires thorium metal with low carbon content and small grain size and the use of a special extrusion lubricant. Integrally coextruded end closures were accomplished with a preshaped aluminum-6 wt % magnesium alloy for the closures and a low coextrusion temperature. Several short-core tubes with integral end closures were made for irradiation tests in the Materials Testing Reactor. (auth)

51056 (NMI–7005) COEXTRUSION OF URANIUM TUBES WITH THIN ZIRCONIUM CLADDING. Larson, W. L. (Nuclear Metals, Inc., Concord, Mass.). 15 Nov 1962. Contract AT(30-1)-1565. 91p. Dep. NTIS.
Declassified 25 Oct 1971.

Conditions established for the coextrusion of uranium tubes with 5-mil zirconium cladding were applied to the preparation of tubes with the external dimensions of Mark VIIA elements. Techniques were established for brazing the ends of such elements. A special heat treatment was developed to refine the uranium grains throughout the cores of these specimens. (auth)

51057 (RDT-M–3-5-T(8-72)) AUSTENITIC STAINLESS STEEL WELDED TUBING (ASME SA-249 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1972. 11p.

A standard prescribing requirements for austenitic stainless steel welded tubing (ASME SA-249 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 3-5T, dated July 1971. (J.R.D.)

51058 (RDT-M–3-32-T(8-72)) SEAMLESS MEDIUM CARBON STEEL BOILER AND SUPERHEATER TUBES (ASME SA-210 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1972. 8p. RSO.

A standard prescribing requirements for seamless medium carbon steel boiler and superheater tubes (ASME SA-210) with additional requirements for nuclear and associated applications is presented. (J.R.D.)

51059 (RFP–1876) IMPROVED MAGNESIA STIRRERS FOR PLUTONIUM ELECTROREFINING. Smith, Carl J.; Leggett, Ronald L.; Teter, Alton R. (Dow Chemical Co., Denver, Colo. Rocky Flats Div.). 14 Jul 1972. Contract AT(29-1)-1106. 7p. Dep. NTIS.

During electrorefining processes, stirrers are used to agitate plutonium metal and the electrolyte. Stirrers in use must withstand conditions of high temperature, thermal shock, abrasion, and chemical attacks during 36-hour cycles. The major cause of magnesia stirrer failures used in electrorefining cells has been from effects of thermal shock. By closely controlling entry and withdrawal rates from the molten salt, stirrer longevity was increased considerably. Other failures caused by poor process control have been eliminated by improving concentricity, thickness, and increasing fired density. Details of a new stirrer design with better reliability for longer use and also available for lower stirring speeds which reduce seal and bearing failures are given. (auth)

51060 TEMPERATURE RISE DURING FILM DEPOSITION BY RF AND DC SPUTTERING. Lau, S. S. (Bell Telephone Labs., Inc., Allentown, Pa.); Mills, R. H.; Muth, D. G. J. Vac. Sci. Technol.; 9: No. 4, 1196-1202(1972).

The temperature rise during film deposition by rf sputtering of Ta, Au, and Pd films and dc sputtering of Ta films has been investigated. The film temperature was measured for various cathode to anode distances, as a function of applied power used for sputtering and sputtering time. It was found that by sputtering from water-cooled cathodes at power levels between 0.1 and 2 kW, the contribution due to radiation from the plasma and the cathode is negligible. To a first approximation, heating is caused in varying amounts by the kinetic energy of the sputtered atoms, the latent heat of condensation of the sputtered atoms, and electron bombardment. The film temperature also depends on the optical emissivity of the deposited materials causing the temperature of films with higher emissivities such as Pd to remain significantly lower for comparable sputter times and power. For dc sputtering from an uncooled cathode, it was estimated that radiation from the cathode contributes significantly to the heating of the sputtered films. (auth)

51061 STAMPING HARD-TO-FORM MATERIALS UNDER HIGH HYDROSTATIC PRESSURES. Volchkevich, T. A.; Maksimov, L. Yu. Kuznechno-Shtampovochnoe Proizvod.; No. 4, 9-12, (Apr 1972). (In Russian).

Aspects of design processes and tooling for stamping materials under high hydrostatic pressures are discussed. The study involved low-plasticity metals including gray iron, silicon iron, magnesium, molybdenum, and aluminum–beryllium alloy to show the significant increase of their technological plasticity during upsetting. The measurements include the punch movements, hydrostatic pressure in the container, and pressures in the hydraulic system. Cited are the stamping parameters for presses of 315 to 3150 tonf operating under constant hydrostatic pressures up to 20,000 kgf/cm^2. (JPRS)

51062 METALLOTERMICHESKIE METODY POLUCHENIYA SOEDINENII I SPLAVOV. (Metallo-Thermal Methods of Producing Compounds and Alloys). Kornilov, A. A. Novosibirsk, USSR; Izdatel'stvo Nauka Sibirskoe Otdelenie (1972). 80p.

Metallo-thermal methods of obtaining intermetallic compounds and alloys are, in a number of cases, more economical and technologically more convenient than the direct alloying of components. The metallo-thermal synthesis of compounds and alloys involves the reduction of oxides, halides, and other substances, and the optimum conditions, mechanism, and kinetics are described for many systems, including Mo–Ni–Al from the oxides of Ni and Mo. The production of $MoGe_2$ from MoO_3, $MeAl_4$ (where Me = La, Ce, Pr, Nd, or Sm) from the corresponding Me oxide, and WGe_3 from GeO_2, WO_3 and Al is outlined. The specific electrical conductivities are tabulated for several germanides: Ti_5Ge_3, Zr_5Ge_3, Hf_5Ge_3, $ZrGe_2$, $HfGe_2$, Zr_3Ge, Cr_3Ge, Mo_3Ge, Mo_5Ge_3, $Mo_{13}Ge_{23}$, and $MoGe_2$. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 50500, 50508, 50776, 52264, 52272, 52279, and 52319.

51063 (AD–738092) STRUCTURE AND DECOMPOSITION OF Zr AND Ti BCC SOLID SOLUTIONS. Sass, Stephen L. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 16 Dec 1971. Contract N00014-67-A-0077-0012. 42p. (MSC–1713). NTIS.

The literature concerning the decomposition of Zr and Ti alloys is reviewed with particular emphasis on the bcc (beta) to athermal omega transformation and the structure of Zr and Ti bcc solid solutions. Illustrative examples are taken principally from the Zr–Nb and Ti–Nb systems. High resolution dark field electron microscopy, diffraction, and ultrasonic techniques have been used to follow the beta to omega phase transformation in Zr and Ti alloys. The omega morphology was shown to consist of 10 to 15 Å diameter particles arranged in ⟨111⟩ rows. As well, clusters of rows were present in low solute content alloys and the cluster size decreased with increasing solute content. The mechanism of the transformation is discussed in terms of instability or metastability of the bcc structure relative to a 2/3 ⟨111⟩ longitudinal displacement wave. (auth) (NTIS)

51064 (AD–738093) SYMMETRY OF THE STRUCTURE OF THE OMEGA PHASE IN Zr AND Ti ALLOYS. Sass, Stephen L.; Borie, Bernard (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 19 Jan 1972. Contract N00014-67-A-0077-0012. 12p. (MSC–1729). NTIS.

The symmetry of the structure of the as-quenched omega phase, which is formed during the decomposition of bcc (beta) solid solutions in Zr and Ti-base alloys, was shown to change from 6-fold to 3-fold with increasing solute content. These observations indicate that as the undercooling beneath the M (s) curve for the beta to omega transformation decreases, the magnitude of the displacement of the atoms away from their bcc positions during the transformation also decreases. (auth) (NTIS)

51065 (AD–738123) BALL INDENTATION TESTING OF HEAVY TUNGSTEN ALLOYS. Test Report. Carosiello, Daniel (Frankford Arsenal, Philadelphia, Pa.). Jan 1972. 28p. (FA-T–72-1-1). NTIS.

A study was conducted to ascertain the relative strength and quality of four heavy as-sintered tungsten alloys by ball indentation type testing such as that afforded by the Brinell testing machine. The basic parameters of indentations formed at different test loads were measured. The parameters included the recovered diameter and the recovered depth of penetration. The results were expressed as Meyer hardness values in kg/s mm^2 where the load is divided by the projected area of the indentation. Meyer values were also derived from the recovered depth of the indentation. Tension properties and densities were determined for comparison to indentation test results. (auth) (NTIS)

51066 (AD–738599) EFFECT OF IMPURITIES AND TEMPERATURE ON THE INTERFACIAL FREE ENERGIES AND SURFACE DIFFUSION OF REFRACTORY METALS. Final Report, January 1, 1969–March 1, 1972. Allen, B. C. (Battelle Columbus Labs., Ohio). 25 Feb 1972. 65p. (AROD–3974:10-MC). NTIS.

The average surface free energies of chromium, molybdenum, and tungsten have been measured at 0.6 to 0.8 of the absolute melting temperature by multiphase equilibrations with liquid tin or silver in tantalum-gettered argon. With grain boundary groove angles measured by interferometry and stylus profile tracing, the respective values were found. (auth) (NTIS)

51067 (CEA-R–4303) ELECTRON MICROSCOPE STUDY OF THE DECORATION OF STRUCTURAL DEFECTS, PARTICULARLY STACKING FAULTS, AND ITS EFFECT ON CREEP OF A Au–Nb AUSTENITIC STEEL. Gelpi, Angel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1972. 116p. (In French). Dep. NTIS (U. S. Sales Only). Thesis. Submitted to Univ. of Paris, Orsay, France.

This study concerns an investigation of various aspects of the precipitation of NbC in an austenitic steel and the relations between these aspects and the mechanical creep behavior of the steel. Five types of intragranular precipitation of NbC were established, one of these types being the precipitation occurring on the stacking faults. In order to understand the formation of these decorated stacking faults, a method was developed which enabled distinctions to be made with the electron microscope between decorated stacking faults and precipitated layers and an unambiguous determination of their nature (intrinsic or extrinsic). This determination is not possible using classical methods because of the superposition of the contrast resulting from the precipitates and stacking faults. It was thus possible to account for the different structures obtained and to consider their creep behavior. Creep measurements indicate that when the steel does not contain decorated stacking faults the creep rate dependence upon the stress is expressed by the following law: $\dot{\epsilon}\ \alpha\ \sigma^{n}$, where n varies between 3 and 8. In contrast, if the steel is rich in decorated stacking faults, the creep rate dependence upon the stress follows a linear law: $\dot{\epsilon}\ \alpha\ \sigma$, different from that observed with most other alloys. This law is explained in terms of the small spacing between the decorated stacking faults which inhibits the formation of the Frank network. (auth)

51068 (EGG–1183-2285) CHARACTERIZATION OF THIN-FILM HEAT SENSORS. Charest, J. A.; Schlueter, W. A. (EG and G, Inc., Goleta, Calif.). Oct 1971. Contract AT(29-1)-1183. 32p. Dep. NTIS.

Thin-film heat sensors (chromel-alumel coaxial thermocouple and platinum-pyrex thermoresistor) were subjected to thermal pulses using Q-switch laser, xenon flashtube, and shock tube arrangements. Both sensors showed rise time capability to less than 50 nsec when subjected to 30-nsec duration delta function laser heat sources. Following the induced heating, the temperature of the thermocouple and thermoresistor decayed with time power dependence of −0.55 and −0.65, respectively. Longer (~2 msec) heating with the flashtube showed that the thermocouple output reached its peak value earlier than the thermoresistor despite the much faster rise time of the thermoresistor during the initial portion of the heating cycle. Thermocouple output also decayed much faster than that of the thermoresistor later in the heat cycle. Predicted outputs of the heat sensors using heat transfer model and numerical folding techniques with the measured delta function response agree well with the experimentation for the thermoresistor, but do not reproduce well the thermocouple experimental data. Shock tube experiments to produce hot streaming gas impulses showed substantial lags in the heat sensors' responses (rise times, maximum temperature) with respect to the values predicted from shock hydrodynamic equations. The differences in the predicted and measured output values suggest that boundary layer effects and gas mixing strongly control the heat transfer rate from moving gas to a stationary solid. The chromel-alumel thermocouple and the platinum-pyrex thermoresistor survived the flow of high temperature, high velocity gas without apparent damage. (auth)

51069 (JAERI-Memo–4021) METALLURGICAL INVESTIGATIONS ON THE CLADDING FAILURE IN THE JPDR PRESSURE VESSEL. IV. THE EFFECT OF FREQUENCY OF LOADING ON THE FATIGUE OF LOW ALLOY STEEL IN RECIRCULATING DEIONIZED WATER ENVIRONMENT. Kondo, Tatsuo; Kikuyama; Toshihiko; Suzuki, Masaki (Japan Atomic Energy Research Inst., Tokyo). May 1970. (In Japanese). NTIS (U. S. Sales Only).

The joint effects of water temperature and cycling rate of fatigue testing on the fatigue crack propagation were examined on ASTM A 302 grade B steel plates under cyclic bending. Within the range of the room temperature to 90°C, the propagation was accelerated with increasing temperature, while at fixed temperature conditions, the lower the cycling rate the greater the acceleration of crack propagation. Such a trend was found to be saturated at an extreme of the testing condition employed, i.e., at 90°C, 3 cycles/min. According to the observation there seemed to have been some particular combinations of temperature and the cycling rate that might give maximum acceleration to the crack propagation in the deconized water environment. Lowering of the cycling rate, however, was also accompanied with another trend of the stagnation of the crack growth under certain conditions, namely at higher temperatures with lower strain amplitudes, although the occurrence was probability in nature. It is suggested that at practical BWR conditions either acceleration or stagnation of the fatigue crack propagation would result depending on the combination of mechanical and chemical factors associated with the corrosion fatigue system. (auth) (Japan)

51070 (LA-4981) SOME PROPERTIES OF SEVERAL HIGH-DENSITY COMPOSITES. Eash, D. T.; Zukas, E. G.; Green, W. V. (Los Alamos Scientific Lab., N. Mex.). Jul 1972. Contract W-7405-eng-36. 14p. Dep. NTIS.

Three commercial high-density composites were studied. They included Gyromet 1100 (90% W–4% Ni–2% Fe–4% Mo), Kennertium W–2 (96% W–4% (Ni + Fe), and Kulite A–5 (95% W–5% (Ni + Fe). These composites were made by powder metallurgy techniques where high-density was achieved by liquid-phase sintering tungsten powder with nickel and iron, and perhaps minor amounts of other additives. Tensile tests, compressive tests, and bend-ductility tests were run at various temperatures, but generally over the range from –80°C to 200°C. Fractography was done using the scanning electron microscope. Young's modulus, shear modulus, and Poisson's Ratio were determined by sonic methods from liquid nitrogen temperature up to 500°C. Fractography studies showed that low temperature failure was by cleavage of the body-centered-cubic tungsten-rich dispersoids, and at the higher temperatures, by ductile tearing of the face-centered-cubic matrix. The transition from one mode of failure to the other occurred in the vicinity of room temperature. Thus, the course for future study can be divided very nicely into two parts. Below room temperature, the tendency toward cleavage of the dispersoids must be lessened to achieve adequate ductility, whereas above room temperature, the matrix must be strengthened. Since alloying additions will be partitioned between the dispersoids and the matrix, the proper alloying addition will have to ductilize, and perhaps soften, the tungsten-rich dispersoids while at the same time hardening and strengthening the matrix. (auth)

51071 (MND-3283-1) RFD-2 PROGRAM, SUMMARY GROUND TEST REPORT. (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). 28 Aug 1963. Contract AT(30-1)-3283. 170p. Dep. NTIS.

Declassified 2 Nov 1971.

Parameters, data, results, and conclusions of an experimental ground test program designed to demonstrate the characteristic behavior of space power system materials and components when exposed to a reentry environment are summarized. The conclusions will be used to predict and evaluate the expected performance of the Reentry Flight Device-2 (RFD-2) experiment and the safety aspects of future space power systems. The program consisted of a high temperature materials compatibility test, two series of plasma jet tests, and a wind tunnel test. Materials compatibility tests were run to determine the static reaction rate of Haynes Alloy No. 25 with graphite when protected by various metal foil materials at elevated temperatures. Plasma jet tests were conducted to investigate, under simulated dynamic reentry conditions, the behavior of tantalum, the high temperature characteristics of Haynes-25, the ablation rates of generator housing and insulation materials (magnesium and Min-K), and the reaction rates of molten Haynes-25 with heat accumulator block materials (graphite and boron nitride). Wind tunnel tests were run to expose the heat accumulator and fuel capsule assembly to an equivalent environment of Mach 20 at an altitude of 200,000 feet. The objectives of this test were to measure separating moments and record on film the disassembly of the component parts. (auth)

51072 (NAA-SR-Memo-8708) CROLOY BOILER EVALUATION. Shulman, S. L. (Atomics International, Canoga Park, Calif.). 10 Jul 1963. Contract AT(11-1)-Gen-8. 7p. Dep. NTIS.

Declassified 4 Nov 1971.

The use of Croloy in the SNAP II boiler was investigated. Results of a program to develop a Croloy boiler using a hydrogen diffusion barrier are presented. (auth)

51073 (ORNL-4783) REPRESENTATION OF CREEP OF METALS. Onat, E. Turan; Fardshisheh, F. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 134p. Dep. NTIS.

A critical review is given on the subject of mathematical description of creep behavior of metals for the purposes of structural analysis. A physical background of creep phenomenon is given along with the representation of creep behavior that is nonlinear and hereditary. Topics of the four chapters included are: review of experimental evidence concerning creep of metals; representation of mechanical behavior by means of state variables; integral representations of mechanical behavior; and analysis of structures in the presence of creep. The need for the development of methods for obtaining bounds on the deformation of creeping structures and also on the motions of the state points in the individual state spaces of the elements of the structure is pointed out. (77 references). (P.C.H.)

51074 (ORNL-TM-3882) X-RAY DIFFRACTION AND TRANSMISSION ELECTRON MICROSCOPY STUDY OF RECOVERY AND RECRYSTALLIZATION IN NIOBIUM AND NIOBIUM-40 VANADIUM. Guthrie, Paul Vincent Jr. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 310p. Dep. NTIS.

Thesis. Submitted to Cincinnati Univ., Ohio.

The isothermal recovery of heavily cold-rolled Nb and a Nb–40 wt. % V alloy was studied using x-ray diffraction techniques, transmission electron microscopy, and hardness. Prior to the initiation of recrystallization in Nb, the effective particle size, root mean square strain, integral breadth, and hardness all recovered linearly with the logarithm of annealing time. Recovery in Nb could be divided into four time and temperature dependent regions: Region I, annealing out of excess point defects leading to strain aging effects; Region II, annihilation and rearrangement of dislocations within cell walls and attraction of interior dislocations to the cell walls, resulting in the formation of subgrains; Region III, normal subgrain growth through the elimination of common subgrain boundaries; and Region IV, formation of abnormal subgrains and their growth by boundary migration, leading to recrystallization. Activation energies increased with increasing recovery, varying continuously from ~30,000 cal/mole at zero recovery to ~98,000 cal/mole at complete recovery. The former value is in good agreement with the activation energy for the migration of point defects in Nb, while the latter value closely coincides with the self-diffusion activation energy. Calculations based on various recovery models support dislocation climb as the principal rate controlling mechanism, provided the activation energy for diffusion is allowed to vary with the state of perfection of the lattice. Recovery of the alloy occurred in a different manner. No large scale regrouping of dislocations was observed during the early stages of recovery, with the initial dense, random dislocation array tending to anneal out uniformly. Patches consisting of stress-eliminating arrays dispersed in a matrix of random dislocations developed. As recovery continued, large scale rearrangements of dislocations into cell-like configurations took place, with the stress-free networks possibly providing the nuclei for the formation of low-angle cell walls. These cells became the nuclei for recrystallization as their interiors became sufficiently clear of dislocations. Subsequent migration of these boundaries left a trail of "hairpin" shaped dislocation loops extending radially into each recrystallization nucleus. A mechanism of grain boundary glide is discussed, whereby individual boundary dislocations encountering a sufficiently high resistance to glide are left behind the migrating wall by the production and extension of kink or jog pairs. Nb–40 V was more resistive to continued recovery than Nb with regard to either applied or homologous temperatures in the range of 500 to 800°C. Such behavior, in contradiction to the apparent self- and inter-diffusion activation energies, is related to the nature of the as-deformed dislocations substructures and the manner in which they recover. The effective particle size determined from x-ray diffraction was not found to be a measure of the average dislocation cell or subgrain size determined by transmission electron microscopy. No simple correlation was found between these two parameters, although both were found to increase uniformly for increasing annealing times at a given temperature. (156 references). (auth)

51075 (ORNL-TM-3890) IRRADIATION EFFECTS ON SELECTED NERVA MATERIALS. Progress Report, July–September 1969. (Oak Ridge National Lab., Tenn.). 24 Jul 1972. Contract W-7405-eng-26. 51p. Dep. NTIS.

An apparatus was constructed to permit cryostatic irradiation and annealing of beryllium with in situ measurements of thermal and electrical conductivities in the Bulk Shielding Reactor (BSR). Dosimetry experiments in the BSR utilizing seventeen foil types were completed and are in excellent agreement. Calculations of the flux spectrum are being improved. Damage functions for Be have been obtained and will be used to relate fluences in the BSR and NERVA applications. Thermal and electrical conductivity and thermopower data are presented on unirradiated reflector Be in the parallel orientation over the temperature range 80 to 400°K. Similar results are given for PO-3 graphite. (auth)

51076 (RFP-Trans-102) MEASUREMENT OF POROSITY OF VACUUM ALUMINUM COATINGS. Roikh, D. L.; Kovalenko, V. B.; Koltunova, L. N. Translated for Dow Chemical Co., Rocky Flats Div., Golden, Colo., from Zavod. Lab.; 37: No. 3, 314-15 (1971). 2p. Dep. NTIS.

The use of an optical microscope for the quantitative determination of porosity and in the analysis of the distribution of pores according to their dimensions for Al coatings is described. (T.D.)

51077 (Y-1843) ELECTRICAL CONDUCTIVITY AND MECHANICAL PROPERTY MEASUREMENTS ON A COLD WORKED AUSTENITIC STAINLESS STEEL. Reeves, C. A. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 30 Jul 1972. Contract W-7405-eng-26. 191p. Dep. NTIS.

Measurements were made on a sheet of well documented 316 stainless steel in order to determine the effects of cold working upon the electrical conductivity and mechanical properties of the material. The sheet was cut into smaller sheets, and these were cold rolled in increments of approximately 10% from 0 to 50%. Mechanical property measurements were then made on the plates both parallel and perpendicular to the rolling direction. A computer controlled testing machine system was utilized for most of the tests, which allowed determination of mechanical property results to an overall accuracy of at least 1 to 2%. Electrical conductivity measurements were made by two techniques: the first was the time honored one of dc measurements which were made on the mechanical property test specimens prior to testing, and the second was the relatively new method of non-destructive measurement by eddy current methods. Excellent agreement was obtained between the eddy current and dc measurements as well as excellent correlation being obtained with the mechanical property test results. A total change in conductivity of approximately 3% was noted for a 50% increase in cold working. An increase of approximately 6.5% in the tensile strength of the material was evident over the same range of cold working. (auth)

51078 MECHANISMS OF DIFFUSION IN METALS AND ALLOYS. Seeger, Alfred (Atomic Energy Board, Pretoria). J. Less-Common Metals; 28: No. 2, 387-418(Aug 1972).

A survey is given of the mechanisms of diffusion in crystals, with emphasis on self-diffusion in metals and on recent developments. Particular attention is devoted to the problems arising in attempts to deduce reliable information on point defects in crystals from diffusion data. The isotope effect for the so-called dissociative mechanism of impurity diffusion is discussed and shown to be in agreement with recent measurements of the isotope effect of silver diffusion in lead. The interpretation of the diffusion behavior of the "anomalous" metals is considered. It is argued that in $\beta-$Zr, $\beta-$Ti, $\beta-$Hf, and $\gamma-$U the anomalous properties are associated with effects of the phase-transition on monovacancy properties, whereas in other metals that have been classified as "anomalous" it reflects a particularly strong divacancy contribution to diffusion. (auth)

51079 SOME RECENT STUDIES OF DOMAIN STRUCTURES IN CRYSTALS. Amelinckx, S. (SCK-CEN, Mol, Belgium). J. Less-Common Metals; 28: No. 2, 325-55(Aug 1972).

The geometrical aspects of domain formation in crystals are discussed, in particular in relation to the observation of interfaces by means of electron microscopy. The contrast effects which allow recognition of different types of interfaces are briefly summarized and it is shown how the image characteristics can be used to determine the geometry of the interfaces. A number of case studies are presented including the domain structure in Ni_4Mo and showing how the different types of interfaces can be identified. The antiphase boundary configurations in Ni_3Mo is the basis for introducing the concepts of a "dissociated antiphase boundary." The domain formation owing to small displacements of atoms or ions in the interstices of the structure are discussed in the cases of niobium ditelluride and in the manganese spinels. In this last class of compounds it is assumed that the domains result from the cooperative Jahn–Teller effect. The domain structure which results from the ordering of structural vacancies in pyrrhotite are also described. (auth)

51080 ZIRCONIUM HYDRIDE PRECIPITATES IN ZIRCONIUM. Bedford, A. J.; Miller, D. R. (Univ of Adelaide). J. Aust. Inst. Metals; 17: No. 2, 120-4(Jun 1972).

Two types of zirconium hydride precipitate in zirconium have been distinguished by electron microscope techniques. In thin zirconium foils the larger precipitates observed, which are resolvable by optical microscopy, have been identified with a $\{10\bar{1}0\}$ habit plane. The more numerous small hydride precipitates which also form are shown to occur principally on the surface of thin zirconium foils and can be identified with an (0002) habit plane. (auth)

51081 THERMODYNAMICS AND VAPORIZATION OF THORIUM, HAFNIUM, AND ZIRCONIUM. Ackermann, R. J.; Rauh, E. G. (Argonne National Lab., Ill.). J. Chem. Thermodyn.; 4: No. 4, 521-32(Jul 1972).

The vapor pressures of liquid thorium, solid and liquid hafnium, and liquid zirconium were determined by a combination of mass-effusion and mass-spectrometric techniques. Single crystal tungsten cups were used as containers. The substantial solubility of tungsten in both liquid hafnium and zirconium markedly extends the liquid range as a result of eutectic behavior. The measured partial pressures corrected for the respective solubilities via Raoult's law therefore yield the vapor pressures of the pure metals over ranges of temperature in which the liquids are in part supercooled. The results derived for the pure metals are given by linear equations in terms of the enthalpies and entropies of vaporization. The measured vapor pressures and enthalpies are consistent with the thermodynamic properties of the vapor and condensed phases and yield the following average values for the enthalpies of sublimation at 298.15°K: $\Delta H^0(Th) = (142.8 \pm 1.1)$ kcal$_{th}$ mol^{-1}, $\Delta H^0(Hf) = (148.4 \pm 1.2)$ kcal$_{th}$ mol^{-1}, and $\Delta H^0(Zr) = (143.4 \pm 1.2)$ kcal$_{th}$ mol^{-1}. (auth)

51082 LOW TEMPERATURE DIFFUSION OF COBALT AND CADMIUM IN SILVER. Teller, C. M.; Stark, J. P. (Univ. of Texas, Austin). Acta Met.; 20: No. 9, 1077-84(Sep 1972).

The diffusion of ^{109}Cd and ^{60}Co in monocrystalline silver was investigated over a temperature range from about 375 to 650°C using a chemical film sectioning technique. Penetration depths studied were limited to a region that has previously exhibited unusually steep penetration profiles for high temperature diffusion of ^{60}Co in Ag. This anomalous behavior or near-surface effect is characterized by abnormally low diffusivities for penetration depths up to several microns from the surface. For both of the isotope tracers, a near-surface effect was observed at the higher temperatures of the range. However, the diffusivities measured at the lower temperatures were in agreement with extrapolations of high-temperature lattice diffusion data in the literature. An apparent transition in diffusion mechanism was noted from plots of the logarithm of the diffusivity vs the reciprocal of the absolute temperature. The transitional behavior is described in terms of oxidation kinetics. A possible mechanism for the near-surface effect that has an activation energy and pre-exponential factor corresponding to that observed in the transition is discussed in detail. (auth)

51083 EFFECT OF THERMO-VIBRO-VOLUME TREATMENT ON THE PHYSICO-MECHANICAL PROPERTIES OF WC–8 PERCENT Co ALLOY. Tumanov, V. I.; Yurevich, R. V.; Silin, R. I.; Sapozhnikova, F. L. (Lvov Polytechnic Inst.). Fiz.-Khim. Mekh. Mater.; 8: No. 1, 66-8(1972). (In Russian).

The widely-used industrial alloy VK8 (WC – 8% Co) was studied while being subjected to various modifications of a thermo-vibro-volume treatment. Data on the coersive force, magnetic permeability, specific electrical resistance, bending strength, impact strength, and Vickers hardness were obtained. (K.S.W.)

51084 NIOBII V CHERNOI METALLURGII. (Niobium in Ferrous Metallurgy). Lyakishev, N. P.; Pliner, Yu. L.; Rubinshtein, E. A. Moscow; Izdatel'stvo Metallurgiya (1971). 216p.

The physicochemical properties of niobium and its compounds with elements contained in various steels produced by the home industry as well as of slag systems with niobium oxides are outlined. The effects of niobium as an alloy component on the service properties of various steel groups are discussed. Data are presented on ores with niobium concentrations and on the characteristics of their reduction with carbon, silicon, and aluminum. Contemporary techniques of smelting ferroniobium and other niobium-containing alloys are considered, including methods of their addition to the steel bath. A technical-economic evaluation of various methods for producing ferroniobium is proposed. (JPRS)

51085 ADDITIONAL-ELEMENT EFFECTS ON THE AGEING PHENOMENA IN Al–4 PERCENT Cu ALLOYS. Khan, A. Q. (Catholic Univ., Louvain, Belgium). Trans. Jap. Inst. Metals; 13: No. 3, 149-54(May 1972).

Starting from the hypothesis that elements with low solubility in Al have higher binding energies with vacancies than copper atoms and that the size of the added element could affect the precipitation behavior, a number of elements, Pb, Cd, W, Be, Na, and Ge were added to an Al – 4% Cu alloy. The aging process was studied by means of hardness measurements, x-ray analysis, and electron microscopy. Preliminary experiments showed that Pb, W, Na, and Ge did not have any effect and were thus discarded. While the elements Pb, W, and Na were inactive probably because of their insolubility in Al, it was concluded that the binding energy of Ge-vacancy was much lower than reported in the literature. Be, Cd, and Be + Cd showed pronounced effects on the aging characteristics of the binary alloy. The effects of Be on the quenched Al – 4% Cu alloy aged at 220°C differed from that of Cd. (auth)

51086 ROLLING AND ANNEALING CHARACTERISTICS OF MOLYBDENUM FIBER-REINFORCED COPPER COMPOSITES THROUGH INTERNAL FRICTION MEASUREMENTS. Umakoshi, Yukichi; Yamane, Toshimi (Osaka Univ., Suita, Japan). Trans. Jap. Inst. Metals; 13: No. 3, 160-6(May 1972).

The deformation and annealing behaviors of copper composites containing various volume fractions of molybdenum were studied by means of internal friction measurements. The results showed that strain amplitude-independent internal friction of copper composites containing molybdenum more than the critical volume fraction decreased sharply by a low reduction by cold rolling.

This may be attributed to the locking of free vibratile dislocations, which were produced by the difference in thermal expansion coefficient between copper and molybdenum, by cold rolling. Strain amplitude-independent internal friction of pure copper and copper composites containing-molybdenum less than the critical volume fraction increased with increasing reduction by cold rolling; after attaining a peak around 5% reduction by cold rolling, the value decreased and then increased rapidly. Strain amplitude-independent internal friction of the cold rolled pure copper decreased by annealing up to about 100°C (recovery), and at 100 to 150°C (recrystallization) in two steps. Strain amplitude-independent internal friction of the composites decreased by annealing corresponding to the recovery and recrystallization of the copper matrix, but the value increased by annealing above about 200°C. (auth)

51087 SURFACE TENSION MEASUREMENTS OF GROUP IV HIGH-TEMPERATURE METALS. Kostikov, V. I.; Grigor'yev, G. A.; Arkhipkin, V. I.; Agayev, A. D. (Inst. of Steels and Alloys, Moscow). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 3, 25-7 (1972). (In Russian).

Surface tension measurements of refractory titanium, zirconium, and hafnium metals by a method of suction of a cylinder into the molten metal is described and compared with the sessile drop, suspended drop, and drop weight methods used in earlier research. In the suction method the surface tensions of the metals are measured from their force of suction of a solid plate or a cylinder into the melt. A diagram of the surface tension measuring device is shown. Correlation of measurement data shows good agreement with those in earlier papers involving the use of other procedures. The high accuracy of the method coupled with the equally good reproducibility of results makes this method suitable for use in measuring the surface tension of metals featuring extremely high melting points. (JPRS)

51088 PHASES OCCURRING NEAR THE COMPOSITION $Cu_{64}In_{36}$. Jain, Kapoor Chand; Ellner, Miroslav; Schubert, Konrad (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 63: No. 8, 456-61(Aug 1972). (In German).

It was found that the NiAs type phase in the mixture Cu—In is a phase bundle consisting in at least five different phases. The homogeneity ranges of the phases were determined. Two of the phases display a domain structure which appears after appropriate etching. From structural data it may be inferred that the valence electrons are responsible for the phenomena. (auth)

51089 THERMAL CONDUCTIVITY OF THE TRANSITION METALS. Samsonow, Grigori W.; Neschpor, Wjatscheslaw S.; Malachow, Jakow S.; Klimenko, Walentin A.; Kiseljowa, Anna F. (Institut fuer Probleme der Werkstoffkunde, Kiev). Z. Metallk.; 63: No. 8, 490-6(Aug 1972). (In German).

The periodic variation of the thermal conductivity of the transition metals and their neighbors with the number of d electrons is due to variations of the electron contribution to the thermal conductivity. Periodic variations of the electronic thermal conductivity are related to periodic variations of the free Fermi surface. They depend on the periodically varying degree of localization of the metal which is determined by the fraction of stable d^n electron configuration (SAASK) (n = 0, 5, 10) and by the a priori probability of formation of these configurations in the condensed state. The maximum SAASK and a priori probability of formation of these configurations (i.e., the elements of the IIa, VIa, and Ib subgroups) correspond to minimum values of the free Fermi surface (and maximum λ_e). Maximum free Fermi surfaces (and minimum λ_e) correspond to the neighboring elements (of the IIIa, Va, VIIa and $VIII_3$a subgroups) whose d electron number is N = n + 1. The signs of the temperature coefficients of the thermal conductivity exhibit a periodicity which is due to the relative contributions of the effects of enhancement of the Fermi surface with temperature. This, in turn, is due to a decrease of SAASK (increase of the fraction of the collective electrons) and the opposing effect of the decrease of the Fermi surface as a consequence of a general decrease of the Fermi energy of the collective electrons with temperature. The net effect depends on the amount of SAASK and on the a priori probability of formation of the stable d electron configuration. (auth)

51090 DIFFUSION AND ELECTROMIGRATION OF NICKEL IN A NICKEL—MOLYBDENUM ALLOY. Kalinovich, D. F.; Kovenskii, I. I.; Smolin, M. D.; Statsenko, V. M. (Inst. of Problem Material Studies, Kiev). Fiz.-Khim. Mekh. Mater.; 8: No. 1, 112-13(1972). (In Russian).

The method of electro-migration was used to study the state of Ni atoms in the alloy Ni—18% Mo fabricated into wire 0.45 mm in diameter and 70 mm long. A segment of this wire was labeled using ^{63}Ni, and activity measurements were used to indicate the diffusion over the temperature range 950 to 1,350°C. (K.S.W.)

51091 MATERIALS '71. 16th National Symposium and Exhibit, Anaheim, California, April 21—23, 1971. SAMPE, Volume 16. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971). 361p. $28.50. (CONF-710457).

Twenty-eight papers are included; a separate abstract was prepared for each of six. The remaining 22 articles contain information on: corrosion and oxidation; advanced processing of nonmetallics; testing of composites; protective coatings; ablative and structural composites; advanced processing of nonmetallics; and cost evaluation of composite materials. (P.C.H.)

For abstracts of individual papers see: 51029, 51092, 51093, and 51147—51149.

51092 DYNAMIC COMPRESSIVE PROPERTIES OF A METAL-MATRIX COMPOSITE MATERIAL. Ross, C. A.; Sierakowski, R. L. (Univ. of Florida, Gainesville). pp 109-20 of Materials '71. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA. (21 Apr 1971). See CONF-710457.

Uniaxially reinforced tungsten—copper composites were fabricated and compression tested at strain rates in the range of 10^{-5} to 10^{4+} sec^{-1}. Experimental data obtained by use of a conventional material test machine, a pressure bar, and impact tests were correlated with existing analytical models for monolithic materials suitably modified for the composites tested. The influence, of varying strain rate, filament content, and filament diameter, on the dynamic yield stress of the tungsten—copper composites is presented. (auth)

51093 PROTECTIVE COATINGS FOR A HYPERSONIC FLIGHT LOAD-BEARING REFRACTORY ALLOY CONTROL SURFACE. Witt, Robert H. (Grumman Aerospace Corp., Bethpage, N. Y.). pp 162-175 of Materials '71. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA. (21 Apr 1971). See CONF-710457.

A materials effort was made in support of the design, fabrication, and testing of a full-scale control surface (elevon) test article. Two primary areas of the total effort, namely: oxidation screening tests for coating selection at ambient and reduced pressures; and hardware evaluations are discussed. It was found that R512C slurry silicide coating on Ta—10W substrate provides a system that has excellent protective and self-healing qualities up to 3000°F. This coating retains usefulness even after short overshoot exposures to temperatures near 3200°F. Final proof of the usefulness of the approach was demonstrated by cycling a full-scale elevon under extreme conditions with severe thermal shock prevailing in each run. Recommendations are included for future work along these lines. (auth)

51094 ADSORPTION KINETICS AND ELECTRON DESORPTION OF O_2 ON POLYCRYSTALLINE TUNGSTEN. Lopez-Sancho, Jose M.; de Segovia, Jose L. (Centro de Investigaciones Fisicas L. Torres Quevedo, Madrid). Surface Sci.; 30: No. 2, 419-39(Apr 1972).

Electron desorption parameters and sticking coefficients of O_2 adsorbed on polycrystalline tungsten have been studied. Two clearly-distinct adsorption states, β_1 and β_2 are identified with desorption energies of 110 kcal/mol and 96 kcal/mol; the desorption temperatures are 2150 and 1900°K respectively. Desorption from β_1 yields atomic oxygen and from β_2 a complex WO_n. The populations are $n_{\beta_1} = 8.7 \times 10^{14}$ molecules/cm^2 and $n_{\beta_2} = 2 \times 10^{14}$ molecules/cm^2 at 77°K. The sticking coefficients, as a function of coverage for both states, have been determined ($s_{0\beta_1} \simeq 1$, $s_{0\beta_2} = 0.8$ at 77°K and $s_{0\beta_1} = 0.98$, $s_{0\beta_2} = 0.76$ at 300°K), being the experimental points fitted by a theoretical expression. From the values of s_0, ($E_A - E_P$) for both states has been calculated, E_A being the activation energy of chemisorption and E_P the depth of the potential well in the preadsorbed state. (auth)

51095 HALOGENS ADSORBED ON MOLYBDENUM: THEIR SURFACE LIFETIMES AND DESORPTION KINETICS. Scheer, Milton D.; Klein, Ralph; McKinley, John D. (National Bureau of Standards, Washington, D. C.). Surface Sci.; 30: No. 2, 251-62(Apr 1972).

The surface lifetimes of fluorine, chlorine, bromine and iodine adsorbed on a molybdenum surface have been obtained from measurements of the halide ion desorption flux using the modulated molecular beam technique. Measurements were made at temperatures between 1350 and 1850°K and at surface coverages of less than 10^{10} halogen atoms cm^{-2}. The temperature—lifetime data were fitted to an Arrhenius expression from which the binding energies $\bar{l}$, and pre-exponential factors $\bar{\tau}^0$, were obtained: F: $\bar{l} = 4.65$ eV and $\bar{\tau}^0 = 3 \times 10^{-16}$ s; Cl: $\bar{l} = 4.11$ eV and $\bar{\tau}^0 = 3 \times 10^{-16}$ s; Br: $\bar{l} = 3.70$ eV and $\bar{\tau}^0 = 2 \times 10^{-15}$ s; I: $\bar{l} = 3.15$ eV and $\bar{\tau}^0 = 1 \times 10^{-14}$ s. It was concluded that the halogens are adsorbed as strongly bound surface compounds, MoX (where X is either F, Cl, Br, or I) from which gaseous ions and neutral atoms desorb at rates consistent with the Saha–Langmuir relationship. From that relationship and the above data, separate binding energies and pre-exponentials were calculated for ion and neutral desorption. The importance of the desorption of MoX was assessed. (auth)

51096 COERCIVE FORCE AND STABILITY OF $SmCo_5$ AND $GdCo_5$. Den Broeder, F. J. A.; Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 29: 65-71(1972).

At low temperatures the compounds $GdCo_5$ and $SmCo_5$ decompose into the corresponding phases R_2Co_7 and R_2Co_{17}. This transformation is connected with the dependence of the coercive force of powder compacts on sintering temperature. (auth)

51097 LEED STRUCTURES DUE TO INTERACTION OF CO AND O_2 WITH (0001) AND (1010) Re AT 20°C TO 920°C. Zehner, D. M.; Farnsworth, H. E. (Brown Univ., Providence). Surface Sci.; 30: No. 2, 335-62(Apr 1972).

The interaction of CO and O_2 with clean (0001) and (10$\bar{1}$0) Re surfaces, produced by the Ar^+ ion bombardment technique, was studied with a combined LEED–MS system. The results reported previously by Farnsworth and Zehner for the adsorption of CO and O_2 on the (0001) Re surface were confirmed. The exposure of a (0001) Re surface to CO at elevated crystal temperatures produced no additional structures. After a (0001) Re surface was exposed to O_2 in the temperature range 425 to 920°C, half-order beams from a multiple spaced structure were first observed, as in the case at 20°C. A (1 × 1)–ReO structure was present after additional exposures. Adsorption results are compared with McRae's predictions based on the double diffraction model. Adsorption of CO at 20°C on the (10$\bar{1}$0) Re surface occurred with a sticking coefficient close to unity. A (2 × 2)–CO structure formed initially and was eventually followed by a (1 × 1)–CO structure. Heating a CO covered surface at 200 to 615°C produced a (1 × 2)–CO structure. Additional heating at 780°C produced a (2 × 2)–CO structure which was extinguished by heating at 960°C. A comparison of the α and β binding states for CO on Re is made with the desorption temperatures for the CO structures on both surfaces. Only a (1 × 3)–O structure was formed on a (10$\bar{1}$0) Re surface exposed to O_2 at 20°C and was extinguished after heating at 780°C. When the (10$\bar{1}$0) Re surface was exposed to oxygen at pressures of 10^{-4} Torr or higher at temperatures of 615°C or greater, facets parallel to the (10$\bar{1}$1) plane were formed. The facets could be removed, and a (1 × 3)–O structure formed, by heating at 1025°C. Bulk diffusion of oxygen occurred when either crystal surface was exposed to oxygen at temperatures of 615°C or higher. Neither increased surface defect densities nor excitation of the adsorbate enhanced the adsorption characteristics of CO or O_2 on either surface. (auth)

51098 ANOMALOUS LINE BROADENING IN THE LOW TEMPERATURE X-RAY DIFFRACTION PATTERN OF NIOBIUM. Abell, J. S. (Univ. of Birmingham, Eng.); Harris, I. R.; Milne, I.; Finlayson, T. R. J. Less-Common Metals; 29: 104-8(1972).

An anomaly in the x-ray diffraction pattern of a Nb sample in the temperature range of 230°K to the resistivity and internal friction effects is reported. This was interpreted in terms of the presence of H in the starting material. The results also suggest that the mechanism responsible for the x-ray line broadening is active at room temperature after low temperature nucleating, and the effect is thus thought to be associated with a pre-precipitation phenomenon, such as clustering or ordering of the interstitial hydrogen atoms, which results in a distortion of the lattice. (P.C.H.)

51099 Th_6Mn_{23} STRUCTURE AT AN UNUSUAL COMPOSITION: $Tb_{0\ 167}Fe_{0\ 633}Al_{0\ 20}$. Oesterreicher, H.; Pitts, R. (Oregon Graduate Center, Beaverton). J. Less-Common Metals; 29: 100-3(1972).

Aluminum substitution for Fe according to the formula Tb $(Fe_{1-x}Al_x)_5$ was found to produce the Th_6Mn_{23} structure. The materials were induction melted in quartz crucibles under a flow of argon and annealed at 1000°C for about 200 h in evacuated quartz ampules. To assure that no Si pickup was taking place, one preparation of $Tb_{0.167}Fe_{0.633}Al_{0.20}$ was also melted and annealed in a MgO crucible with identical results. Although no complete agreement between calculated and observed intensities could be obtained with the ordering schemes outlined, it seemed clear that $Tb_{0.167}Fe_{0.633}Al_{0.20}$ is of the Th_6Mn_{23} type structure with some unusual ordering tendencies. (P.C.H.)

51100 HIGH-TEMPERATURE CREEP BEHAVIOR OF A TUNGSTEN–3 PERCENT RHENIUM ALLOY WITH THORIUM OXIDE DISPERSION HARDENING WITH DIFFERENT PARTICLE FORMS. Wirth, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt EV, Porz-Wahn, Ger.). J. Less-Common Metals; 29: 41-63(1972). (In German).

The creep and stress-to-rupture behavior of W–3Re–$2ThO_2$ sheet and rod material prepared by powder metallurgy has been investigated in vacuum at temperatures between 1800 and 2200°C. Both types of product showed the same steady-state creep rate over this temperature range, despite the presence of more finely divided oxide particles in the sheet material. On the other hand, the stress–rupture strength for the sheet material was better than that for the rod up to 2200°C. At this temperature the elongated ThO_2 particles began to spheroidize, this process being accelerated by creep deformation. It was concluded from the electron microscopical results, and also from the measured activation energies of creep, that grain boundary sliding is the rate-controlling process. This conclusion also offers an explanation for the similar behavior of both types of product in relation to the steady-state creep rate, and the difference in behavior in relation to the stress-to-rupture strength. Methods of improving the high-temperature strength and creep resistance of these materials are outlined. (auth)

51101 MASS-SPECTROMETRIC STUDY OF THE CHEMISORPTION OF OXYGEN ON TUNGSTEN UNDER TRANSIENT AND STEADY-STATE DESORPTION CONDITIONS. Mazumdar, A. K.; Wassmuth, H.-W. (Univ., Marburg, Ger.). Surface Sci.; 30: No. 3, 617-31(May 1972).

Interaction of oxygen with a polycrystalline tungsten surface has been mass-spectrometrically studied both under transient (flash filament with single slight detection) and steady-state (constant flow) conditions at temperatures T between 1000 and 2500°K and at oxygen pressures pO_2 from 10^{-9} to 10^{-6} torr. Only one binding state each for atomic oxygen, WO_2 and WO_3 as surface species has been observed. Quantitative measurements of the respective surface concentrations show that only up to 0.4% of the total adsorbed oxygen undergoes chemical reactions with the surface tungsten atoms to produce oxides. From the experimentally obtained stationary values of the surface coverage $\theta(T,pO_2)$ together with a coverage dependency of the sticking probability $s(\theta) = 0.7\ (1 - \theta)^2$, the mean residence time $\tau(T,\theta)$ of oxygen atoms has been calculated. The desorption energies of atomic oxygen, WO_2 and WO_3 are determined as functions of coverage and have maximum values for a clean surface as 6.5, 5.0 and 4.5 eV respectively. (auth)

51102 CHEMISORPTION OF CARBON MONOXIDE ON TUNGSTEN: CORRELATION OF REFLECTION–ABSORPTION INFRARED SPECTRA WITH CO BINDING STATE POPULATION. Yates, John T. Jr.; King, David A. (Univ. of East Anglia, Norwich, Eng.). Surface Sci.; 30: No. 3, 601-16(May 1972).

The vibrational frequency of carbon monoxide chemisorbed on an atomically clean polycrystalline tungsten ribbon has been studied using reflectance-infrared spectroscopy and ultrahigh vacuum techniques. The initial appearance of an infrared absorption band at 2093 cm^{-1} is unequivocally associated with the onset of adsorption of the weakly-bound α-CO state, which occurs at coverages where the more strongly-bound β-CO species are already extensively populated. As the α-CO coverage is increased to its maximum value, the infrared band shifts to 2117 cm^{-1}. Partial thermal desorption of the α-CO by pumping at 295°K for ~2000 s causes the band to reversibly shift back to ~2093 cm^{-1}. The band disappears rapidly and completely upon thermal desorption of CO at 403°K, confirming that the absorption band observed in this region of the spectrum is due to α-CO. The spectral frequency indicates that the α-CO species on tungsten are closely analogous to the linear CO moieties found in transition metal carbonyls. The vibrational frequency observed is in close agreement with low energy electron energy-loss measurements made for CO on W(100). A model is proposed for the slight strengthening of the carbon-oxygen bond in α-CO as the CO coverage increases. The model involves coverage-dependent electronic back-donation from surface W atoms into Π-antibonding orbitals as originally proposed by Blyholder for adsorbed CO, and by Jones for certain transition metal hexacarbonyls. (auth)

51103 PROPERTIES OF A MOLYBDENUM–BORON ALLOY PRODUCED IN ELECTRON BEAM OR ARC FURNACES. Chernov, V. S.; Busol, F. I.; Nam, B. P.; (and others). Tsvetn. Metal.; No. 2, 54-5(Feb 1972). (In Russian).

The structure, chemical composition, and mechanical properties of cast and deformed alloys of Mo with 0.005 to 0.03% boron are discussed. Boron powder was incorporated into one electrode of the furnace, the electrode then being wrapped in Mo foil, for producing the alloy. Arc furnace was preferable to the electron furnace. The Mo–B alloy possessed certain properties which were superior to the type MCh metalloceramic molybdenum. (K.S.W.)

51104 MICROSTRUCTURE AND TEXTURE OF β-PHASE MULTIQUENCHED URANIUM RODS. Zelenskii, V. F.; Kunchenko, V. V.; Miroshnichenko, Yu. T.; Roenko, N. M.; Khorenko, V. K. At. Energ. (USSR); 33: No. 2, 677-80(Aug 1972). (In Russian).

The behavior of microstresses in uranium as a function of the

the number of quenching cycles was determined from width changes of x-ray diffraction lines. The observed peak in the curves for rods quenched four times was confirmed by the peak in the curve for microhardness versus the number of quenching cycles. Regularities and specific features of structural changes were established by means of electron-microscope observations of large samples (replica technique). A dislocation impurity network was observed. Microstress relaxation when the number of cycles is more than four or five occurs via slipping, twinning, and dislocation rearrangement. It is proposed that there exists a vacancy mechanism of pore formation at the uranium-nonmetallic impurity interface during cyclic $\alpha \rightleftharpoons \beta$ transformations (quenches). As the number of quenching cycles is increased, no significant changes are observed in the nature and degree of texture perfection, i.e., changes in the level of microstresses and dislocation densities. (auth)

51105 FORMATION OF VAPOR NUCLEI IN HIGH TEMPERATURE MELTS. Levine, Herman S. (Sandia Labs., Albuquerque, N. Mex.). J. Phys. Chem.; 76: No. 18, 2609-14(31 Aug 1972).

A theory for the kinetics of bubble nucleation in binary Zr–O and ternary Fe–C–O melts is developed based on the known surface-active behavior of oxygen and a reasonable model for the vaporization of a single species for each system (ZrO(g) and CO(g), respectively). The formation of vapor nuclei in these systems has been unexplained because of the high surface tension and relatively low vapor pressures known to exist at critical conditions. It is shown that the thermodynamic behavior of both systems is similar and that the electrochemical potential is required to characterize the surface region of the melt because of the charge on the chemisorbed oxygen. Three conditions are required for a vapor embryo to coexist in an unstable equilibrium with the superheated melt, namely, chemical, chemisorptive, and mechanical equilibrium. The latter is in the form of a Laplace equation modified by the electrostatic energy density of the surface region. Because of this change, the reversible work to form the critical embryo is found to differ from the usual $\sigma A^*/3$. These results are incorporated into the classical equations for the nucleation frequency and compared with available results for the two systems. It is found that a small excess oxygen ion concentration in the surface region is sufficient to counteract the very large surface tension barrier to a change of phase. (auth)

51106 SELF-DIFFUSION IN LIQUID ALKALI METALS. Larsson, S. J.; Roxbergh, C.; Lodding, A. (Chalmers Tekniska Hoegskola, Goeteborg). Phys. Chem. Liquids; 3: No. 3, 137-46(Jul 1972).

A recently developed capillary method was employed to study tracer self-diffusion in liquid Na (102 to 284°C) and K (97 to 284°C). The results may be expressed by $D = D_0 \exp(-Q/RT)$, where $10^3 D_0$ Na = 0.86 (+0.09, −0.08) (cm^2/sec), $Q_{Na} = 2.22 \pm 0.08$ (kcal/mole), $10^3 D_0$ K = 0.76 (+0.06, −0.05), and $Q_K = 2.02 \pm 0.07$. The reexamination of electrotransport data for Rb (60 to 230°C) yielded the self-diffusion data $10^3 D_0$ Rb = 0.66 (+0.11, −0.09) and $Q_{Rb} = 1.98 \pm 0.16$. For liquid Li, the results of two investigations (195 to 440°C) have been combined, yielding $10^3 D_0$ Li = 1.44 (+0.07, −0.06) and $Q_{Li} = 2.87 \pm 0.07$. For all four metals the empirical relation $Q \simeq 2.5\, R\bar{T}$ is found to apply ($\bar{T}$ being the mean exp. temp.). Also well obeyed is a nearly linear dependence on $(T - 0.72\, T_m)$ (where T_m is the m.p.). Further, the self-diffusion coefficients at the respective melting points can all be expressed by $D_m = \frac{1}{6}\sqrt{3kT_m}/MV_{mol}^{1/3}\beta$, where M is atomic mass V_{mol} atomic volume and $\beta = 0.11$. Three alternative empirical equations are presented, each about equally well representing the experimental self-diffusion data in Li, Na, K, and Rb. The diffusion characteristic of cesium as predicted from these regularities, is found to obey, as do those of the four other alkali metals, a modified Stokes-Einstein type relation connecting diffusion with viscosity. Accordingly, self-diffusion parameters may be computed also for Cs, $10^3 D_0$ Cs = 0.48 and $Q_{Cs} = 1.86$ kcal/mole. (auth)

Radiation Effects

Refer also to abstracts 50291, 50490, 52257, 52382, and 52383.

51107 (AD–737190) PROCEDURES FOR INTERPRETING THE STRUCTURAL IMPLICATIONS OF RADIATION-DAMAGE SURVEILLANCE RESULTS ON NUCLEAR PRESSURE VESSELS. Final Report. Steele, L. E.; Serpan, C. Z. Jr. (Naval Research Lab., Washington, D. C.). 30 Dec 1971. Contract AT(49-5)-5409. 21p. (NRL–7358). NTIS.

The structural implications of radiation effects to nuclear reactor pressure vessels are assessed primarily through surveillance programs in which the properties of the vessel are projected from an evaluation of small specimens of the vessel steel. In the USA, the current fracture-safe criterion requires that the vessel operating temperature, at certain stress levels, be at the FTE (Fracture Transition Elastic) temperature, defined as NDT + 60°F), derived from surveillance measurements. Review of available data from five reactor surveillance programs indicates that this criterion is adequate for the vessels concerned. Complete assurance of fracture-safe operating conditions can be attained through a limit-analysis procedure that considers and integrates the effects of five factors: (a) the radioinduced shift in transition temperature, (b) the initial shelf energy, (c) the radiation-reduced ductile shelf energy, (d) the effects of the fluence (and toughness) gradient through a thick vessel wall, and (e) the effects of thickness-induced mechanical constraint. (auth) (NTIS)

51108 (AD–738923) DEFECTS STRUCTURE OF NEUTRON-IRRADIATED METALS. Annual Summary Report. Ziebold, Thomas O. (Massachusetts Inst. of Tech., Cambridge). 1 Oct 1968. Contract N00014-67-A-0204-0013. 14p. NTIS.

Selected fracture specimens from the NRL program on the effects of minor elements of the behavior of A302-B steel were examined in the scanning electron microscope and the electron microprobe analyzer. Iron tensile specimens were prepared for irradiation with the NRL pressure vessel simulation experiment in the IRL reactor and for other irradiations in the MIT and UCC reactors. A feasibility study was made to determine whether hydrogen implanted in iron by proton bombardment would form grain boundary bubbles or other observable defects. (NTIS)

51109 (AD–739312) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November 1, 1971–January 31, 1972. Stelle, L. E.; Shahinian, P.; Smith, H. H.; Watson, H. E.; Hawthorne, J. R. (Naval Research Lab., Washington, D. C.). 15 Feb 1972. 41p. (NRL–MR–2398). NTIS.

The research program involving a broad study of the effects of nuclear radiation upon materials is discussed. Research covering the period Nov. 1, 1971 to Jan. 31, 1972 includes: (1) a study on fatigue crack growth rates in several 300 series stainless steels, (2) the effect of irradiation on the fatigue properties of thin section Type 348 stainless steel at 550°F, (3) an evaluation of notch toughness of AISI Type 304 and 316 stainless steel submerged arc weldments, (4) description of a subsize R-specimen for assessments of postirradiation fracture extension resistance, (5) electron microscopy observations of the postirradiation microstructure of pure iron and dilute iron alloys, (6) mechanisms of vacancy generation in laser bombarded targets, and (7) the cyclotron simulation of helium transmutation damage in 304 stainless steel. (auth) (NTIS)

51110 (INIS-mf–72, pp 112–20) NEW MATERIALS IN THE FIELD OF RADIATION. Goggin, B. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1970. (CONF-700844–1). INIS.

From New materials symposium; Sydney, Australia (27 Aug 1970).

The development of materials for application in present and future nuclear power reactors is reviewed, with emphasis on alloys used as cladding on nuclear fuel elements. In particular, neutron effects on magnesium, beryllium, and zirconium alloys and stainless steels are discussed. (INIS)

51111 (JAERI-Memo–4077) BEHAVIOR OF BORON IN STAINLESS STEEL DETECTED BY FISSION TRACK ETCHING METHOD AND EFFECT OF RADIATION ON TENSILE PROPERTIES. Kawasaki, Satoru; Hishinuma, Akimichi; Nagasaki, Ryukichi (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese and English). NTIS (U. S. Sales Only).

The behavior of boron in stainless steel was studied by using the fission $^{10}B(n,\alpha)^7Li$ reaction. Boron atoms in steel in the temperature range 750 to 850°C segregate to grain boundaries easily by aging. The relation between time for segregation and temperature is a nose type curve and in 316 stainless steel boron segregates most quickly at about 820°C. The grain boundary segregation of boron that occurred in the aged specimen caused appreciable ductility loss in the post-irradiation tensile testing at an elevated temperature, compared with the solution treated specimens irradiated and tested under the same conditions. The segregation of boron on grain boundaries by aging was found to cause appreciable loss of post-irradiation ductility loss at elevated temperatures. In the post-irradiation tensile test, the cold-worked specimen showed reduced ductility at lower temperatures, while as the testing temperature was increased ductility was recovered to reach the value equivalent to the solution annealed specimens. (auth)

51112 (KFK–1571) CREEP CAPSULE FOR FUEL AND JACKET MATERIAL. Haefner, H.; Neumann, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1972. 42p. (In German). Dep. NTIS (U. S. Sales Only).

Creep data of the fuel and cladding material are necessary prerequisites to the design of advanced fuel elements for nuclear reactors. In-pile capsules for cladding and structural materials have been developed which allow the in-pile measurement of elongations of the samples under axial pneumatic stress. An inductive measurement system was selected for the capsules. A minimum of two samples can be irradiated at a time in each rig. This results in advantages, both in terms of time and expense, of these in-pile experiments relative to existing facilities. Systems of measurement are described along with a creep capsule for irradiation of cladding and structural materials in the Belgian BR2 reactor at Mol. A fuel creep capsule is also described for the PR2 research reactor at Karlsruhe together with operating experience and results. (auth)

51113 (ORNL–4801, pp 87-99) CHEMICAL SUPPORT FOR SOLID-FUELED REACTORS. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.

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51114 (SCL-CR–710180) PULSED ELECTRON BEAM TESTS–DISTENDED MATERIALS. Lutze, A. (Physics International Co., San Leandro, Calif.). Sep 1971. Contract 20-7277. 121p. Dep. NTIS.

For Sandia Corp., Livermore, Calif.

Results of electron beam experiments to obtain the pressure generation-energy deposition relationship for distended materials, and to obtain data to aid in the analysis of a two-wave pulse structure present in distended materials are presented. The materials under investigation were porous copper and aluminum. The test matrix was designed to reveal material response dependences on: material density variations—60, 75, 90, and 100% theoretical density; pore size—0, 1, 10, and 50 microns; fabrication history—sintered and cold pressed; and sample thickness—10, 35, 75, and 100 mils. Experimental evidence suggests a strong dependence of impulse generation on porosity. Measured impulse decreased to approximately 20% of its nonporous value as pore sizes increased to 10 microns. Beyond that, an upward trend is indicated by the 50 micron data at approximately 75% of the nonporous impulse value. (J.R.D.)

51115 (UCRL–51224) PROTON SIMULATION OF DISPLACEMENT EFFECTS INDUCED IN METALS BY 14-MeV NEUTRONS. Logan, C. M. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Jun 1972. Contract W-7405-eng-48. 24p. Dep. NTIS.

In designing a D–T fusion reactor, one must know the effect of a high flux of 14-MeV neutrons on structural materials. Available laboratory sources of 14-MeV neutrons are not intense enough to achieve realistic flux levels in samples. Bombardment with other particles is one way of simulating the expected neutron flux levels. The energy spectrum of atoms recoiling from collisions with bombarding particles can be calculated from elastic-scattering and nonelastic-reaction data for the incident species. This analysis shows that 16-MeV protons closely simulate the displacement effects caused by 14-MeV neutrons. In niobium the average damage energy per incident 14-MeV neutron is 2.6×10^{-25} MeV-cm^2/atom. Electron-excitation losses and threshold effects have been accounted for. The damage energy deposited per incident 16-MeV proton is 6×10^{-25} MeV-cm^2/atom. Protons are a useful unexploited tool for investigating the effects on materials of irradiation with high-energy neutrons. (auth)

51116 STUDIES OF FAST NEUTRON INDUCED SWELLING. Wazzan, A. R.; Zaleski, P. (Univ. of California, Los Angeles). Nucl. Eng. Int.; 17: No. 195, 629-32(Aug 1972).

Recent developments in studies of fast neutron and charged particle irradiation-induced swelling in austenitic stainless steel, nickel, and nickel-base alloys are reviewed. Although some advance has been made it appears that the mechanism through which dislocations, γ phase and NbC precipitates control void formation is not well understood. (auth)

51117 SURFACING OF 304 STAINLESS STEEL FOR LIQUID SODIUM SERVICE. Douty, R. A.; Schwartzbart, H. (Rockwell Mfg. Co., Pittsburgh). Weld. J. (N. Y.); 51: No. 8, 406s-416s (Aug 1972).

The properties of Type 304 stainless steel surfaced with AWS ECoCr-A type alloys for use in valves operating in molten sodium at 1200°F were evaluated. Specimens subjected to thermal shock cycling to evaluate the effects of surfacing process, dilution, and deposit thickness were examined by metallography, hardness tests, dye penetrant inspection, and electron microprobe analyses. (auth)

51118 RADIATION AND TEMPER EMBRITTLEMENT PROCESSES IN ADVANCED REACTOR WELD METALS. Hawthorne, J. R. (Naval Research Lab., Washington, D. C); Fortner, E. J. Eng. Ind.; 94: No. 3, 807-14(Aug 1972).

Experimental weld filler metals having high resistance to radiation embrittlement at ≈550°F have been developed for quenched and tempered A543 and A542 steel. The filler metals are from a special $2\frac{1}{4}$ Cr–1 Mo–0.40 Si–0.10 C composition series formulated to study the effects of variable copper, nickel, and manganese contents on weld performance. An evaluation of weld deposit performance is presented based on new Charpy-V (C_v) and tension data and an analysis of temper embrittlement and radiation embrittlement processes. High fluence assessments confirm the high resistance to radiation embrittlement of the low copper content filler metal group. A 530°F irradiation of one typical submerged arc weld deposit to a fluence of 3.8×10^{20} n/cm^2 > 1 MeV did not elevate its C_v 30 ft-lb transition temperature to above 275°F or reduce its C_v shelf energy level to below 50 ft-lb. Radiation embrittlement saturation was not evident. Temper embrittlement and radiation embrittlement development and the probable mechanisms of copper and phosphorus influences on radiation embrittlement sensitivity are analyzed with the aid of experimental data for the weld metals and A543 plate. Temper embrittlement and radiation embrittlement are shown to be additive effects which can occur simultaneously or sequentially. A separate component of irradiation effects, manifested as a strength increase without embrittlement, is revealed. The enhancement of radiation sensitivity by high copper content ($\geqq$16 to 0.27% Cu) is related to a copper influence on the radiation elevation of yield strength; the enhancement of radiation sensitivity of phosphorus is ascribed to a detrimental effect similar to that of temper embrittlement. It is proposed that copper acts to pin radiation-induced defect aggregates and dislocation arrays in the matrix and that phosphorus segregates during irradiation to weaken the interface of ferrite platelets and carbides. (auth)

51119 MICROHARDNESS OF Ni, Cu, AND Al AFTER IRRADIATION WITH HIGH ENERGY PARTICLES. Reutov, V. F.; Konyakhin, N. A.; Tuev, V. M. Fiz.-Khim. Mekh. Mater.; 8: No. 1, 80-4(1972). (In Russian).

As a result of irradiating Ni and Cu at about 150°C with 21 MeV protons and 42 MeV alpha particles in fluxes of $\sim 10^{18}$/cm^2, the microhardness of the metals increased over the penetration depth of the particles. In aluminum samples an increase in microhardness was observed only in the zone which had been impregnated with hydrogen. The structural changes in Cu and Al after proton irradiation were limited to the zone of the intruded gas. (K.S.W.)

51120 EFFECTS OF NEUTRON RADIATION ON THE CATALYTIC ACTIVITIES OF LITHIUM-DOPED COPPER, NICKEL, AND COPPER–NICKEL. Takeuchi, Toyosaburo; Miyatani, Daisaku; Takada, Yutaka; Okamoto, Kinji (Toyama Univ., Japan). J. Phys. Chem.; 76: No. 18, 2625-30(31 Aug 1972).

The effects of lattice imperfections produced by the nuclear reaction of ^{6}Li(n,α)^{3}H upon the catalytic activities in the hydrogenation reaction of ethylene on powdered copper, nickel, and copper–nickel which had previously been doped with lithium and irradiated with thermal neutrons were investigated. In addition, the amount of tritium taken from the catalyst was measured by placing it in contact with normal hydrogen and raising the temperature of the catalyst. The irradiation of neutrons increased the activities of nickel and copper–nickel by 3 to 4 times, but it did not affect the activity of copper. The dependence of the amount of tritium upon the composition of the catalyst was very similar to that of the catalytic activity, suggesting that the diffusion of tritium from the interior is the rate-determining step. (auth)

Other Materials

Refer also to abstracts 50498, 51075, 51091, 51094, 52252, 52255, and 52313.

51121 (DP-Report–603(Pt.1)) GRAPHITE IRRADIATION EXPERIMENTS IN H.F.R. PETTEN. PART I. CAPSULE DESIGN AND SAMPLE MEASUREMENT TECHNIQUES. Project DRAGON. Blackstone, R.; Voice, E.; Graham, L. W.; Everett, M. R. (Atomic Energy Establishment, Winfrith (England)). Nov 1968. 51p. Dep. NTIS (U. S. Sales Only).

The design and operation are described of a series of eight graphite irradiation capsules operated in H.F.R. Petten to obtain property change data for H.T.R.'s. Constant temperatures are maintained in the three sections of capsule operating at 600, 900, and 1200°C respectively by a combination of γ-heating and electrically operated heaters. Measurement techniques for neutron dose, dimensional change, coefficient of thermal expansion, electrical resistivity, Young's Modulus, and the characterization of pyrocarbons are described. (auth)

51122 (DP-Report–606) CONSIDERATIONS RELATING TO EXPERIMENTS ON THE EVAPORATION OF FISSION PRODUCTS FROM GRAPHITE. Project DRAGON. Rowland, P. R. (Atomic Energy Establishment, Winfrith (England)). Nov 1968. 32p. Dep. NTIS (U. S. Sales Only).

The evaporation of fission products from a solid such as graphite is considered in terms of the laws of ideal solution. It is shown that it is convenient to express the results in terms of an "effective net drive" and an "effective exit resistance." Physically this is equivalent to transforming vapor-phase quantities into graphite-phase counterparts by using the equilibrium constant for evaporation as an amplifying factor. Two limiting-case approximations are discussed, i.e., the reversible system where the evaporation redeposition reaction at the surface is only slightly displaced from equilibrium and the irreversible case where evaporation only is considered. It is shown that reversibility may be defined in terms of a "redeposition ratio," q, such that for reversibility $q > 1$ and for irreversibility $q < 1$. The ratio q is dependent on the sticking factor, S, for vapor-phase atoms striking the solid. For a power reactor it is estimated that reversibility holds if $S > 10^{-3}$. It is shown that the assumption of reversibility yields the lowest exit resistance, i.e., the limiting case maximum evaporation rate and should therefore be used in safety calculations whenever there is a doubt as to the value of the sticking factor. For a power reactor the numerical value of the exit resistance is approximately equal to the equilibrium constant, K, for solution of the vapor in the graphite. These conclusions indicate the need to obtain adequate experimental data on equilibrium constants and sticking factors under conditions relevant to power reactor environments. (e.g., with respect to fission product concentration and coolant impurity levels). Extension of the model to non-linear systems, i.e., those in which there is departure from the ideal laws of dilute solution, is briefly discussed. (auth)

51123 (FRNC-TH–194) PARTICULAR APPLICATIONS OF CORPUSCULAR AND ELECTROMAGNETIC RADIATIONS IN MODIFYING THE PHYSICAL PROPERTIES OF OPTICAL GLASSES. Sinai, Philippe J. (Paris Univ., Orsay (France). Faculte des Sciences). 18 Mar 1971. 137p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The correction of spherical aberrations in lenses by local modification of the refractive index can be effected by irradiation. The action of slow and fast neutrons on glasses was studied. The quantitative aspect of the action of radiations on the refractive index was studied. The laws concerning the variation of the refractive index were established, thus permitting the spherical aberrations of lenses to be corrected. The method employed for modifying the refractive index using neutron irradiation is described in detail, the results obtained being given. The different criteria which limit the possible applications of the method developed are reviewed. Particular attention is given to the time stability of the index modifications, the possibility of eliminating irradiation induced coloring effects in the glasses, the mechanical quality, and the absence of radioactivity. Radioactivity measurements on the different types of glass led to practical results concerning the choice of glasses used. Other applications of this method are envisaged. (France)

51124 (GULF-GA-A–12080) EFFECT OF TEMPERATURE HISTORY ON THE DIMENSIONAL CHANGES OF IRRADIATED NUCLEAR GRAPHITES. Engle, G. B. (Gulf General Atomic Co., San Diego, Calif.). 30 Jun 1972. Contract AT(04-3)-167. 20p. Dep. NTIS.

Artificial graphites were irradiated initially to fluences of about 3×10^{21} n/cm^2 at T_1 of 1200 or 1000°C and then to higher fluences at T_2 of about 1000 or 800°C, respectively. The dimensional changes did not deviate significantly from the isothermal curve for T_1, the higher temperature. (auth)

51125 (GULF-GA-A–12137) THERMAL CONDUCTIVITY CHANGES IN NUCLEAR GRAPHITES AT HIGH TEMPERATURES AND HIGH FLUENCES. Engle, G. B.; Koyama, K. (Gulf General Atomic Co., San Diego, Calif.). 30 Jun 1972. Contract AT(04-3)-167. 13p. Dep. NTIS.

An anisotropic needle-coke graphite and an isotropic Gilsocoke graphite were irradiated at 560°C to 1455°C at fluences of 1.40 to 800×10^{21} n/cm^2 ($E > 0.18$ MeV) and thermal conductivity measured at room temperature. There is a strong temperature effect; thermal conductivity degradation is reduced with increasing temperature and fractional changes ranged from 20 to 25% at 1450°C, when measured at room temperature. (auth)

51126 (IAEA-R–869-F) REED–PLASTIC COMBINATIONS PREPARED BY IRRADIATION WITH GAMMA-RAYS AND LINEAR ELECTRONS. Final Report, February 1, 1970–July 31, 1971. Simionescu, C. (International Atomic Energy Agency, Vienna (Austria)). Jan 1972. 16p. INIS.

Grafting of reed with either methyl methacrylate (MMA) or acrylonitrile-styrene (ANS) was carried out by gamma-ray induced polymerization or electron beam irradiation. A mixture of monomer/alcohol/water in the ratio of 5 : 4 : 1 was chosen to facilitate the impregnation of the fibers. In the case of MMA the degree of grafting varied between 37 to 59% over a range of 0.5 to 5 Mrad by gamma irradiation, and 20 to 26% over a range of 1 to 50 Mrad by electron beam irradiation. The following compositions of ANS mixture were tested: acrylonitrile/styrene = 1 : 3, 1 : 5 and 1 : 9. Degree of grafting varied randomly according to the total dosage and composition of ANS mixture. For gamma irradiation composites contained 12 to 38% grafted copolymer and for electron beam irradiation results indicating high percentage of grafting were observed for high dosage over a grafting range of 15 to 60%. Grafting phenomena were studied by means of infrared spectrophotometry, x-ray diffraction, thermal analysis, and electron microscopy. Improved tensile strength of reed was observed in the case of MMA, while improved impact strength was made possible by grafting with ANS mixture. (INIS)

51127 (MLM-CF–66-12-508) EVALUATION OF OUR LUBRICANTS THAT ARE RESISTANT TO TRITIUM. (Mound Lab., Miamisburg, Ohio). 1966. 7p. Dep. NTIS.

51128 (NAA-SR-Memo–8452) LITHIUM HYDRIDE TECHNOLOGY IIA: FABRICATING THE SNAP 10A TEST CONTAINER AND THE TEST SHIELD. Welch, Frank H. (Atomics International, Canoga Park, Calif.). 3 May 1963. Contract AT-11-1-GEN-8. 46p. Dep. NTIS.

Declassified 2 Nov 1971.

Two stainless steel containers were filled with lithium hydride using the casting process. The first container, a test can, simulated the SNAP 10A shield in size and volume; the second container was an actual SNAP 10A shield vessel with a modified lower head. Both cast containers held about 200 pounds of lithium hydride. The casting equipment and the casting process functioned as planned, producing two sound castings. Both castings were free of shrink-pipes and casting voids, although low density or cracked areas were noted along the center line of the castings. Both exhibited lithium hydride bulk densities in excess of 93 percent (greater than 0.72 grams per milliliter) which is equal to or better than the average cold pressed lithium hydride (with honeycomb) density. It was concluded that the lithium hydride casting process showed great promise as a cheap, versatile, and fast method of producing SNAP shadow shields. (auth)

51129 (UCRL–51252) HIGH-PRESSURE MECHANICAL PROPERTIES OF MERLIN ALLUVIUM. Bonner, B. P.; Abey, A. E.; Heard, H. C.; Schock, R. N. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Jul 1972. Contract W-7405-eng-48. 25p. Dep. NTIS.

Mechanical properties measurements for desert alluvium from borehole Ue3-ct, Nevada Test Site, have been made as a function of pressure up to 30 kbar. Pressure-volume relations, compressive shear strength, shear response during uniaxial strain, and ultrasonic compressional velocity are reported. Data include results for large (10 to 15 cm diam by about 20 cm) samples prepared from intact recovered cores. Compressions of ~30% occur under quasihydrostatic pressures of 30 kbar, with 65% of this deformation taking place in the first 2 kbar. Shear strengths (τ) vary with water content for samples fabricated from the same alluvium; τ = 600 bars for the air dry material and 2 bars when the material is water saturated (mean pressure $\cong$2 kbar). The uniaxial strain loading path (strain rate $\cong 10^{-5}$/sec) approaches the failure envelope in deviatoric stress/mean stress space at $\tau \cong$ 100 bars and $P_m \cong$ 365 bars. (auth)

51130 NEW RADIO-TRACER TECHNIQUE FOR THE MEASUREMENT OF SELF-DIFFUSION COEFFICIENTS OF ORGANIC LIQUIDS IN POLYMERS. Toh, H. K.; Ware, A. R.; Wetton, R. E. (Loughbourgh Univ. of Tech., Eng.). Nucl. Instrum. Methods; 103: No. 1, 93-8(1972).

A method is described for measuring the self-diffusion coefficient of volatile organic molecules in polymer membranes without approximation procedures. A carbon-14 labelled organic vapour is allowed to exchange with an identical non-labelled vapour through a polymer membrane in a previously evacuated system. The liquid reservoir for the non-labelled species contains scintillator and allows the increase in concentration of labelled molecules with time to be followed by liquid scintillation counting. The characteristics of the liquid scintillation solution, 0.5% 2,5 diphenyloxazole in decane, were determined and compared with those for a more conventional system. Counting efficiencies of 65% are obtained with reservoir temperatures in the range 20° to 60°C. Membrane temperatures must be higher than reservoir temperatures. (auth)

51131 LOW-TEMPERATURE GRAPHITIZATION OF COKES AND BINDER-FILLER ARTIFACTS. Engle, G. B. (Gulf General Atomic, Inc., San Diego, Calif.). Carbon; 10: 409-15(1972).

A series of metal-doped cokes or compacts was prepared with aluminium or titanium and heat treated at 1700 to 2300°C. Aluminium-doped cokes and compacts readily converted to graphite at 2300°C. The percentage of graphite structure produced exceeded the original aluminium content by a factor of from 3 to 13 depending on the original metal content in the baked material. When carbon structure is converted to graphite, the Al_4C_3 evolves from the material. Graphite compacts fabricated with aluminium were highly crystalline but had low bulk densities due to the evolution of the aluminium during heat treatment. Titanium was not as effective in converting disordered carbon to graphite below 2300°C. When aluminium and titanium were present together, the conversion to graphite was more complete than when aluminium alone was used. (auth)

51132 DEPENDENCE OF THE LATTICE THERMAL EXPANSION PERPENDICULAR TO THE LAYER PLANES OF PYROCARBONS ON THEIR STRUCTURAL PROPERTIES. Pellegrini, G. (Joint Nuclear Research Center, Petten, Netherlands). Carbon; 10: 487-90(1972).

The lattice thermal expansion perpendicular to the layer planes (α_c) was measured between room temperature and 1200°C on a large variety of pyrocarbon structures deposited in a fluidized bed as coatings on nuclear fuel particles. A correlation of α_c with the structural and physical properties characterizing the deposits indicated that a linear relationship exists between α_c and the apparent stack size L_c, α_c increasing with L_c. High resolution electron micrographs of such pyrocarbons showed that the crystallites are spherulite-shaped particles with the layer planes bent parallel to the external surface. Polygonization of the spherulites associated with growth is believed to furnish indicative elements for an explanation of the dependence of α_c on L_c. (auth)

51133 ELECTRONIC CONTRIBUTION TO THE THERMAL EXPANSION COEFFICIENTS OF GRAPHITE CRYSTALS. Kelly, B. T. (Atomic Energy Research Establishment, Springfields, Eng.). Carbon; 10: 439-41(1972).

Calculations were made of the lattice contribution to the principal thermal expansion coefficients of graphite crystals. It was expected that the electronic contribution to the expansion coefficients would be dominant at very low temperatures as in the electronic and lattice components of the specific heat. Recent studies of the pressure dependence of the electronic properties of graphite crystals yielded the changes of energy band parameters with interlayer spacing. The values of these parameters were used to estimate the electronic contribution to the expansion coefficient parallel to the hexagonal axis. (auth)

51134 CHANGE IN THE PROPERTIES OF NUCLEAR GRAPHITES OBTAINED BY MIXING DIFFERENT COKES. Cornuault, P.; Lore, J.; Rappeneau, J.; Yvars, M.; Mottet, P. (Compagnie de Produits Chimiques et Electrometrometallurgiques, Pechiney, Paris). Carbon; 10: 463-70(1972). (In French).

Several pitch bonded molded graphites were made using two very different cokes as filler materials, one being isotropic, and the other one a needle petroleum coke. They were mixed in various proportions. The physical, mechanical and thermal characteristics of these carbons were studied. The properties were found to vary linearly in parallel with the composition of the mix. Dimensional variations resulting from neutron irradiation were simulated by a bromination method. In most cases the linear dependence on mixing ratio was obeyed. Nuclear graphites having desired properties can therefore be obtained by mixing different cokes. (auth)

51135 EFFECT OF THE RATE OF GRAPHITISATION OF CARBON PRODUCTS ON DIMENSIONAL CHANGES CAUSED BY NEUTRON IRRADIATION. Rappeneau, J.; Yvars, M.; Mottet, P.; (and others) (CEN de Saclay, Gif-sur-Yvette, France). Carbon; 10: 471-80(1972). (In French).

Two types of baked carbon were graphitized by heat treatments at rates varying from 50 to 3300°C/h. It was found that for both types of carbon, an increase in the heating rate led to considerable changes in the texture of the graphitized product, particularly in the apparent density, helium density and in microporosity. In view of these textural differences in graphitized products, different dimensional effects of neutron irradiation were predictable. A method of simulation by bromination showed this to be the case. An irradiation experiment at 550°C to doses of about 3.5×10^{21} n/cm/h Dido Equivalent Nickel confirmed the results obtained by bromination. (auth)

51136 EFFECT OF ADSORBED PHOSPHORUS OXYCHLORIDE ON THE OXIDATION BEHAVIOR OF GRAPHITE. McKee, D. W. (General Electric Co., Schenectady, N. Y.). Carbon; 10: 491-7 (1972).

The effect of adsorbed $POCl_3$ on the topography and rate of oxidation of natural graphite crystals was investigated. The adsorbate increased the activation energy for the oxidation reaction and inhibited etch pit formation on the basal plane surfaces of the crystals. Adsorption of $POCl_3$ at peripheral sites and prismatic surfaces of the crystals was less strong than at dislocation cores in the basal planes, where residual adsorbate remained on the surface even at temperatures as high as 900°C. Small amounts of adsorbed $POCl_3$ significantly raised the oxidation temperature of graphite and inhibited the catalytic effects of metallic impurities such as copper. The adsorption and inhibiting effect of $POCl_3$ was enhanced by pretreatment of the graphite with mild aqueous oxidizing solutions. (auth)

51137 EFFECT OF ENVIRONMENT ON THE MECHANICAL ANISOTROPY OF POLYCRYSTALLINE GRAPHITE. Vitovec, F. H.; Stachurski, Z. H. (Alberta Univ., Edmonton, Can.). Carbon; 10: 417-28(1972).

The fracture behavior of extruded Speer graphite Type RC-4 and molded POCO graphite Type AXF-Q1 was investigated using Tattersall—Tappin type bend tests. Because of the anisotropy of the extruded graphite the properties were tested in four directions on each of three significant planes relative to the extrusion direction. Tests were performed in air, in vacuum, and on water soaked specimens at room temperature; other tests were performed in vacuum at 750°C and on specimens which were outgassed at 750°C and tested in vacuum at room temperature. Polar diagrams of the properties were used to relate the environmental effects with the structure of the graphite. A pronounced size effect was observed for Speer graphite under test conditions which produced a stress gradient. (auth)

51138 THERMAL EXPANSION COEFFICIENT OF GRAPHITE PARALLEL TO THE BASAL PLANES. Kelly, B. T. (Atomic Energy Research Establishment, Springfields, Eng.). Carbon; 10: 429-33(1972).

The theory of thermal expansion of a graphite crystal is applied parallel to the basal planes. It is shown that the observed expansion at high temperatures is less than expected. A calculation is made of the effect on thermal expansion of an unusual anharmonicity for the out-of-plane bond bending vibrations. The consequences of this model are discussed with regard to the very low-temperature behavior of the basal expansion coefficient. (auth)

51139 HIGH TEMPERATURE THERMAL EXPANSION OF GRAPHITE PARALLEL TO THE HEXAGONAL AXIS. Kelly, B. T. (Atomic Energy Research Establishment, Springfields, Eng.). Carbon; 10: 435-8(1972).

A calculation was made of the effects on the hexagonal axis thermal expansion coefficient of a graphite crystal of the changes in the interlayer forces due to the large interlayer expansions. It was found that the expansion coefficient is significantly increased at temperatures above 800°K and that the magnitudes of the experimental increases up to 3000°K can be readily accounted for. (auth)

51140 SCANNING ELECTRON MICROSCOPE STUDIES OF OXIDIZED PYROLYTIC GRAPHITE. Horton, W. S.; Ballard, D. B. (National Bureau of Standards, Washington, D. C.). Carbon; 10: 499-502(1972).

Specimens of pyrolytic graphite (PG) that had been previously used for kinetic oxidation studies, as well as some unoxidized specimens, were examined. The principal topographic features of oxidized PG faces included circular holes with flat bottoms and various depths. Some holes were basin-like at the top. The hole walls were striated showing layers parallel to the deposition surface. The bottom side (i.e., nearest the substrate) was more extensively oxidized than the top, and the hole diameters were an order of magnitude larger. In contrast to these essentially cylindrical pits were a few with the shape of a paraboloid of revolution. The edges had indications of circular holes also. However, a nibbled effect appeared more common. A major feature of a thick specimen was the non-uniformity of attack as a function of distance from the substrate surface. The large scatter of the earlier kinetic data is attributed to this varying reactivity. (auth)

51141 NMR ABSORPTION OF POLYTETRAFLUOROETHYLENE SINTERED AFTER IRRADIATION. Tutiya, Mituaki (Tokyo Metropolitan Isotope Research Center). Jap. J. Appl. Phys.; 11: No. 8, 1219(Aug 1972).

Polytetrafluoroethylene samples were enclosed in an evacuated glass tube, irradiated by ^{60}Co γ rays, sintered at 380°C for about 30 min, and cooled or quenched. The fraction of narrow line component in the irradiated sample was estimated to be smaller at 10°C and larger at 50°C than that in the unirradiated one. An unexpected increase in line width took place around room temperature for the case of cooling rate of 0.2°C/min. The NMR results suggest that the molecular chains of the polytetrafluoroethylene begin to disintangle easily as a result of irradiation when the sample is cooled from 380°C. (M.C.G.)

51142 RELAXATION OF POLYMER DEFORMATION UNDER THE INFLUENCE OF RADIATION. Stepanov, V. F. (Physical-Technical Inst., Moscow). Fiz.-Khim. Mekh. Mater.; 8: No. 1, 69-74(1972). (In Russian).

Relaxation processes of radiation creep were studied for nonoriented films of polycarbonate and styroplex during the application of loads (2.3 to 3.5 kg/mm^2) at temperatures of 25 and 41°C, respectively. Creep was not instantaneous, but began 10 to 20 sec after the onset of 0.5 MR/sec. The observed effects indicate the presence of active products of irradiation in the polymers which are capable of disrupting chemical bonds. (K.S.W.)

51143 EFFECT OF γ-IRRADIATION ON PROPERTIES OF EPOXY DIANE RESIN ED-6. Shokot'ko, S. G.; Savchenko, V. I.; Meleshevich, A. P.; Tadeush, V. A. (Kiev State Univ.). Fiz.-Khim. Mekh. Mater.; 8: No. 1, 74-8(1972). (In Russian)

The effects of agents such as tripolyphosphate, acetone, butanol, and toluene on samples of gamma irradiated polyethylene were evaluated. The durability and swelling of the samples after exposure for several hours were assessed. Parallel experiments were conducted with samples of polyethylene in an electron accelerator after doses of 12 MR. Such irradiation significantly increased the mechanical stability and durability of polyethylene samples. (K.S.W.)

51144 IMPROVED METHOD FOR THE IMPREGNATION OF POROUS MATERIALS FOLLOWED BY RADIATION-INDUCED POLYMERIZATION AND CROSS-LINKING. Pierlas, Rene; Guibert, Michel (to Conservatome Industrie). French Patent 2,082,491. 10 Dec 1971. Filed 18 Mar 1970. (In French).

A process for improving the physical properties of an object made of wood, plaster or porous material was developed. The object is permeated with a polymerizable liquid; it is then coated with a liquid layer of a protecting material which produces oxidizable products when irradiated. The liquid layer is solidified and the polymerizable liquid is cross-linked under irradiation. A colloidal bitumen emulsion can be used as the protecting material. (France)

51145 HIGH-TEMPERATURE X-RAY STUDY OF RARE-EARTH SILICIDES. Mayer, I.; Felner, I. (Hebrew Univ., Jerusalem). J. Less-Common Metals; 29: 25-31(1972).

The structures of AlB$_2$ and Mn$_5$Si$_3$-type hexagonal and Cr$_5$B$_3$- and ThCr$_2$Si$_2$-type tetragonal rare-earth silicides have been investigated by high-temperature x-ray diffraction in the temperature range 20 to 1200°C. Thermal expansion coefficients and transition products of the different compounds are given. (auth)

51146 ELLIPSOMETRIC STUDY OF 400-eV ION DAMAGE IN SILICON. Ibrahim, M. M.; Bashara, N. M. (Univ. of Nebraska, Lincoln). Surface Sci.; 30: No. 3, 632-40(May 1972).

Lattice damage in silicon induced by low-energy argon ions is characterized ellipsometrically in two ways. In one the optical model consists of residual surface contamination and the partially-damaged substrate. The characterizing parameter in this case is an apparent substrate index N's which is a composite of the refractive indices of the damaged and undamaged portions of the substrate. Alternatively the damage can be analyzed using a three-layer model consisting of residual surface contaminant, the damaged layer and the underlying undamaged substrate. Using the latter model the spatial extent of the damage and the optical constants of the damage layer can be determined The bombardment causes an increase in the absorption in the infrared, a decrease in the reflectivity in the ultra-violet, and broadens the absorption edge. The degree of damage increases with ion energy and can be removed by annealing at 800°C. (auth)

51147 DEVELOPMENT OF FABRICATION PROCESSES FOR HYBRID BORON–GRAPHITE FILAMENT COMPOSITES. Penton, Allen P. (Philco-Ford Corp., Newport Beach, Calif.). pp 59-64 of Materials '71. Azusa, Calif.; Society of Aerospace Materials and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA. (21 Apr 1971). See CONF-710457.

A process was developed for combining boron and graphite filaments in the same epoxy matrix composite. The result was a family of composites that appears to have improved mechanical properties over that which is achievable with either boron or graphite fibers by themselves. (auth)

51148 ADVANCED COMPOSITE COST COMPARISON. Dial, D. D.; Howeth, M. S. (General Dynamics, Fort Worth, Tex.). pp 302-14 of Materials '71. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA (21 Apr 1971). See CONF-710457.

Relative cost comparisons of advanced composite applications with conventional material components are presented. Specific detailed comparison studies are described on several components selected from the F-111A supersonic fighter-bomber. These comparisons include material and labor required to fabricate the wing trailing edge panel, wing pivot fitting doubler, and wing pivot fairings. The wing trailing edge components were manufactured on a research and development or limited production basis to determine applicability, versatility, and production environment relationship of advanced composite materials to conventional structural materials and did not prove to be cost-competitive. The other two components described were produced with either boron-epoxy or graphite-epoxy materials and are currently in production. Both of these applications were found to be cost-competitive with other approaches using conventional materials. Cost competitiveness as used here compares total installed cost only and dose not consider the value of weight savings obtained. The engineering advantages offered by advanced composites are significant and material costs are decreasing; therefore, continued application assessment is imperative. (auth)

51149 PENETRATING RADIATION INSPECTION OF MULTIDIRECTIONAL REINFORCED RESIN MATRIX COMPOSITES. Cook, John L. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.); Gulley, Lee R. pp 345-54 of Materials '71. Azusa, Calif.; Society of Aerospace Material and Process Engineers (1971).

From sixteenth national SAMPE symposium and exhibit; Anaheim, CA. (21 Apr 1971). See CONF-710457.

Fabrication and application of multidirectional reinforced resin matrix composites has made it necessary to develop means of inspection and nondestructive analysis. Woven multidirectional reinforcements have exhibited defects and irregularities in the weave pattern. Penetrating radiation inspection techniques have shown distinct applicability; and film radiography, x-ray Vidicon, and neutron radiography were evaluated. Film radiography was able to reveal internal weave defects and irregularities and visual correlation with these defects was accomplished. X-ray Vidicon evaluations were also conducted on the unimpregnated weave, and neutron radiography was conducted on the fully impregnated and cured composite. Neither the Vidicon x-ray or neutron radiography was able to add significantly to the results of the x-ray film radiography. Film radiography has provided significant improvement in the inspection of woven reinforcements. As a result of in-process x-ray, major improvements were made in the quality of the woven material. Continued investigation of penetrating radiation techniques promises further improvements in reinforcement quality and in nondestructive analysis techniques. (auth)

51150 FISSION GAS RELEASE FROM UO_2-DISPERSED GRAPHITE DURING IRRADIATION. Shiba, K.; Handa, M.; Yamagishi, S.; (and others) (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Energy; 26: No. 7, 333-48(Jul 1972).

In-pile release of ^{85m}Kr, ^{87}Kr, ^{133}Xe, ^{135}Xe, and ^{138}Xe from natural graphite was measured over a temperature range of 100 to 950°C, and that of ^{133}I and ^{135}I was estimated. The effects of fission rate and fission density on the fission gas release were examined. The β-decay process of iodine within and outside the graphite was observed to control the gross release of xenon. Possible mechanisms of an anomalous sink of ^{88}Kr in the plot of log R/B versus log λ were discussed. A model for knock-out release was proposed on the basis of the temperature dependence found. These results were compared with those of post-irradiation experiments and explained by a mechanism whereby fission gas is trapped in defects created in graphite by fission and β-decay energy, and released through annealing of the defects. (auth)

51151 MANUFACTURE OF MACROMOLECULAR BONDED EXPLOSIVE SUBSTANCES. Bex, Guy; Bourbon, Bernard; Lutfalla, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,087,382. 6 Dec 1971. Filed 15 May 1970. (In French).

A process for the manufacture of explosive materials is described in which a macromolecular bonding material (that can be hardened by exposure to ionizing radiations) is mixed with an explosive substance. The mixture is appropriately shaped and then hardened by the action of ionizing radiation. The macromolecular bonding material is made of a modified epoxy resin. The radiation dose is between 0.2 and 4 MRads. (France)

51152 NEUTRON ABSORBING MATERIAL. Brossard, Jean-Pierre (to Societe La Calhene SA). French Patent 2,092,848. 28 Jan 1972. Filed 24 Jun 1970. (In French).

A neutron absorbing material intended for the manufacture of neutron absorbing panels is presented. It consists of a heavily hydrogenated substance e.g. polyethylene; a bonding material distributed under the name of tiolithe and possibly a boron compound. The preparation of this material involves: the possible incorporation of a tiolithe boron compound, the addition of the mixture to the mixing water containing (possibly) a hardening activator, the staining of the mixture, the incorporation of polyethylene granules, and the molding of the material obtained in appropriately shaped molds. (France)

51153 HIGH-TEMPERATURE PHASE EQUILIBRIA IN LITHIUM-, SODIUM-, AND THORIUM-FLUORIDE MIXTURES. Thoma, R. E. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2747-60(Sep 1972).

The equilibrium phase diagram for the lithium-, sodium-, thorium-fluoride ternary system was determined experimentally using standard laboratory methods. Crystallization reactions in LiF-NaF-ThF_4 mixtures were found to result in the occurrence of fourteen singular and invariant equilibrium points at the liquidus, including three eutectics at the LiF-NaF-ThF_4 compositions, 30-56.5-13.5, 43.5-32.5-5-24 and 54.5-13.5-32 mole percent, and at temperatures of 505,509 and 525°C. Peritectic invariant points were found at temperatures as high as 825°C. The high-temperature modification of a crystalline phase, long assumed to be $NaThF_5$, was identified as the hexagonal modification of the compound, 7NaF · $6ThF_4$, space group, P3c1. In this phase lithium was found to exchange for sodium, to a saturation limit where lithium substitutes at approximately two-thirds of the sodium sites. Ternary compound formation was absent in the system. The results of the present study were the basis for a revision of the NaF–ThF_4 phase diagram. (auth)

51154 STUDY OF THE RADIATION-INDUCED CREEP OF POLYMERS AND OF ITS RELATIONSHIP WITH RADIATION-INDUCED ELECTRIC CONDUCTIVITY. Vaisberg, S. E.; Stepanov, V. F.; Sichkar, V. P.; Karpov, V. L. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 14: No. 4, 899-909(Apr 1972). (In Russian).

The dependence of the rate v of radioinduced creep of six polymers (oriented and nonoriented Kapron, poly (methyl methacrylate), polycarbonate, polytetrafluoroethylene, and atactic polystyrene) on the dose rate j, temperature T and stress σ was investigated. The dependence $v \sim j^{\Delta} e^{\beta T+\alpha\sigma}$ established earlier was confirmed. A quantitative relationship was found for the parameters Δ and β required by the model proposed earlier, which takes account of the rupture of stressed bonds caused by interaction with thermal electrons. The dependence of the radioinduced electric conductivity $\varkappa$ of poly (methyl methacrylate) and polycarbonate in loaded state on the dose rate was studied. The value of the parameter Δ depending on $\varkappa \sim j^{\Delta}$ for each of these polymers was found to be the same as in the case of radioinduced creep. (auth)

51155 DEPOSITION RATE OF PYROCARBON IN A FLUIDIZED BED. Iseki, Takayoshi; Wakashima, Yoshikazu; Hase, Teizo; Suzuki, Hiroshige (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 7, 434-6(Jul 1972).

The effects of hydrocarbon concentration and initial bed surface area on the rates of pyrocarbon deposition on fuel particles in fluidized beds were studied. Data are presented and discussed concerning the effects of hydrocarbon concentration on rates and efficiency of pyrocarbon deposition, and on relations between efficiency of pyrocarbon formation and initial bed surface area. (J.R.D.)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 50778.

51156 (LA-4994) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, January–April 1972. (Los Alamos Scientific Lab., N. Mex.). Jul 1972. Contract W-7405-eng-36. 20p. Dep. NTIS.

Research progress is reported on neutron interrogation and nondestructive assay of fissionable materials, materials analysis using isotopic sources, gamma- and x-ray analysis applications, and detector and instrumentation analysis. Results of A-1 field assay operations at Oak Ridge are included. (J.R.D.)

51157 (PTB-ATWD-1/71) POSITION AND MISSION OF THE PTB AS TECHNICAL HIGHER AUTHORITY FOR MEASUREMENT AND CALIBRATION PRACTICE. Muehe, Walter (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Dec 1971. 23p. (In German). Dep. NTIS (U. S. Sales Only).

In more than 100 laboratories, the PTB employs 1300 persons including 300 scientists. In addition to calibration and standardization, the PTB also performs measurements related to safety techniques, explosion protection, noise elimination, radiation protection, and other tasks concerned with environment. As a significant contribution, the six basic units of the international unit system: meter, kilogram, second, ampere, candela, and kelvin were defined, named, and symbolized with all derived subunits. All measurements were performed with a significantly higher precision than that required in routine measurements and production practice. The PTB is a technical higher authority but not a higher calibration office; actual calibration is performed by the respective authorities of the eleven federated states. Examples are given for scales, volume measurements of liquids and gases, electrical measuring devices, and equipment for the measurement of humidity, traffic, temperature, and others. Also discussed are international cooperation and future development of standardization and calibration. (H.B.G.)

51158 RADIOACTIVE SOURCES FOR SAFEGUARDS AND MATERIALS MANAGEMENT. Menlove, H. O.; Forster, R. A.; Foley, J. E. (Los Alamos Scientific Lab., N. Mex.). Isotop. Radiat. Technol.; 9: No. 4, 505-9(1972).

Because of the simplicity and reliability of radioactive neutron sources, they are expected to play an important role for in-plant measurements of fissionable materials and quality control of reactor fuel components. A given nondestructive assay problem requires optimization of the neutron source, moderator, and detector, and strong calculational capability is needed to make preliminary evaluations on the combinations of these three sets of variables. (auth)

51159 GET THE MOST FROM YOUR NUCLEAR FUEL INVESTMENT. Martin, Roger (Duquesne Light Co., Pittsburgh). Elec. Light Power (Boston); 50: No. 13, 42-5(Jul 1972).

Managing nuclear fuel poses both problems and opportunities never encountered in fossil fuel plants. Suggestions are made for handling this $25 million inventory. (auth)

Disposal and Storage

Refer also to abstracts 50419, 50446, 50587, 50595, 50596, 51040, and 52623.

51160 (ARH-SA-115) RADIOACTIVE WASTE ENCAPSULATION AND STORAGE FACILITY. LaRiviere, J. Robert (Atlantic Richfield Hanford Co., Richland, Wash.). Jul 1972. 22p. (CONF-720903-12). Dep. NTIS.

From 20th remote systems technology conference; Idaho Falls, ID, (17 Sep 1972).

The processes and facility, now under construction at Hanford, Wash., that will be used to encapsulate and store ^{137}Cs and ^{90}Sr which have been separated from liquid radioactive wastes and converted to solid CsCl or SrFl$_2$ salts are described. Kilocurie units of ^{137}Cs and ^{90}Sr will be routinely processed. Each capsule produced will contain from 5 to 7 lb of CsCl or SrFl$_2$ and will be 2-⅝ in. in dia by 21-in. long. Plans for radiation monitoring of the plant areas, stack effluent, and cooling water waste streams are mentioned. (L.C.L.)

51161 (BNWL-B-7) COMPATIBILITY STUDIES FOR THE WASTE PACKAGING PROGRAM PRELIMINARY RESULTS. Fullam, H. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct 1970. Contract AT(45-1)-1830. 82p. Dep. NTIS.

The current waste management program at Hanford calls for the isolation, packaging, and long-term storage of ^{137}Cs and ^{90}Sr waste as individual compounds in small high-integrity containers. Preliminary results of compatibility studies for the wastes with various container materials are given. The compounds selected for study were CsCl, $Cs_2U_2O_7$, SrF_2, and $Sr_2P_2O_7$. Cesium chloride and strontium fluoride were considered the optimum compounds and, therefore, received more attention. The test results indicated that 316L stainless steel is the best material to contain CsCl and Haynes 25 is preferred for SrF_2. All test metals were badly attacked by $Cs_2U_2O_7$ and $Sr_2P_2O_7$ at 1000°C. However, the couples tested at 400°C showed very little attack and a variety of metals showed promise for containing these materials at 400°C. (T.D.)

51162 (BNWL-CC-1467) LONG-TERM HAZARD ANALYSIS FOR IN-TANK-SOLIDIFICATION RADIOACTIVE WASTE STORAGE CONCEPT. Unruh, Carl M. (Battelle Pacific Northwest Labs., Richland, Wash.). Jan 1968. 62p. Dep. NTIS.

In-tank-solidification provides a method for storing intermediate-level wastes in a fixed, inherently stable condition with essentially no interactions with its environment. An analysis is made of the long-term hazards associated with this waste storage method using conditions which exist at the tank farm on the 200 Area Plateau near Hanford. These conditions include: the design, construction, and emplacement of the tanks, the waste composition and radioisotope content; the hydrologic, geologic, seismic, and meteorologic conditions of the geographic area; the possibility of external explosions caused by aircraft crashes or weapons; and the animal, human, and plant activities at the waste storage area. (L.C.L.)

51163 (IAEA-133) RADIOACTIVE WASTE MANAGEMENT SYSTEMS. Compilation of Data Received from Member States Based on a Questionnaire Sent Out in July 1969. Wiederhold, E. W. (comp.) (International Atomic Energy Agency, Vienna (Austria)). 1971. 165p. INIS.

Information concerning actual working waste management facilities in 35 Member States who replied to a questionnaire sent by the IAEA to all Member States in July 1969 is tabulated. Information is provided on site, size of operation, environment, disposal practices, type and volume of waste, activity levels and treatment processes. Addresses are provided which can be used to obtain more direct information. (INIS)

51164 (LA-3142) TREATMENT OF NIOBIUM PENTACHLORIDE. ROVER PROJECT WASTE. Patterson, Calvin C.; Fowler, Eric B. (Los Alamos Scientific Lab., N. Mex.). 29 Jun 1964. Contract W-7405-eng-36. 11p. Dep. NTIS.

Disposal of niobium pentachloride solid waste presents a problem due to the reactive nature of the material and to the uranium content. Two approaches to disposal are outlined: the addition of water followed by neutralization with a base to form a precipitate which is resistant to leaching; and treatment with 8N HCl and recovery of uranium on an ion-exchange medium. Flow diagrams and estimates of costs are given. (auth)

51165 (ORNL-4801, pp 101-8) SALT MINE. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.
HYDROGEN—flammability limits in crushed salt, p. 107
LANTHANUM OXIDES—diffusion on surfaces of sodium chloride, p. 107-8
RADIOACTIVE WASTE—disposal in salt mines, stored radiation energy in rock salt from, p. 104
  —stored radiation energy in high-level, p. 105
  —disposal in salt mines, study of gas and water vapor flow through crushed salt in, p. 106
  —disposal in salt mines, research progress on, p. 101-8
SALT DEPOSITS—radiation and thermal chemistry of salt and brines from, p. 103
  —stored radiation energy in, p. 104
SALTS—hydrogen flammability limits in crushed, p. 107
SODIUM CHLORIDES—radiation and thermal chemistry of, p. 103
  —gas and water vapor flow through crushed, p. 106
  —diffusion of lanthanum oxide on surfaces of, p. 107-8
(D.H.M.)

51166 COMPUTATIONAL MODEL FOR THE SELECTION OF VERSIONS IN DISPOSAL OF RADIOACTIVE WASTE FROM NU-

CLEAR PLANTS. Fischer, W.; Buhl, G. (Institut fuer Kraftwerke, Berlin). Kernenergie; 15: No. 2, 63-7(Feb 1972). (In German).

A program is described that permits the economical estimation of technologically reasonable couplings of techniques and technologies for the treatment and final disposal of radioactive wastes from nuclear plants. The results of weighted versions (by prime cost, expenses) may be used, in addition to safety criteria, for decisions in the selection of possible versions. Functional relationships are given. Capacities and limits of the program are discussed. (auth)

51167 RADIOACTIVE WASTE MANAGEMENT. Wallauschek, Emil Int. At. Energy Agency Bull.; 14: No. 2, 33-40(1972).

Aspects of effective systems for management of radioactive wastes are discussed. Included are discussions on radioactivity in the human environment, basic considerations of waste management, choice of waste management methods, use of the environment, the scale of waste management problems, and future trends. (J.R.D.)

Handling Equipment and Procedures

Refer also to abstracts 50370 and 50586.

51168 (CEA-R-4341) INTERPRETATION OF EXPERIMENTS ON AQUEOUS PLUTONIUM NITRATE SOLUTIONS. Caizergues, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1972. 36p. (In French). Dep. NTIS (U. S. Sales Only).

A comparison is presented between experimental results and results obtained from calculations made using the MACAO-SECI 11 program, a program based on the Monte Carlo method which utilizes multigroup energy cross sections. A method enabling the results of critical mass and volume measurements in cylinders containing nitric solutions of plutonium nitrate to be transposed for acidities different from the experimental ones is described. The influence of ^{240}Pu on the critical Pu mass is determined after correction for the effect of the nitric acidity. The critical masses and volumes of spheres of nitric solutions of plutonium nitrate reflected by a thickness of water equivalent to an infinite thickness were calculated by the Sn method. They are given as a function of the Pu concentration for various nitric acidities: 0.2 and 5 N for ^{240}Pu contents of 3% and 10%. (auth)

51169 (KFK-1499) METHOD OF TESTING THE DECONTAMINABILITY OF PROTECTIVE COATINGS, PAVING, AND NONMETAL MATERIALS. Kienhoefer, M.; Kunze, S.; Hepp, H. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1972. 55p. (In German). Dep. NTIS (U. S. Sales Only).

After a brief review of the test procedures for evaluating the decontamination characteristics of protective coatings for use in areas of possible contamination reported so far from the USA, Great Britain, France, CSSR, German Democratic Republic, Japan, Switzerland, and Federal Republic of Germany, the procedure developed in Karlsruhe is introduced which includes physical and chemical investigations in addition to the decontamination test. The reproducibility proved to be satisfactory. Decontamination results of 546 tested industrial products are tabulated. Based on the experiences gained with the materials used in the plants and institutes of the Karlsruhe Nuclear Research Center, also the decontamination characteristics of several plastics, paints, floor coverings, surface fillers, and rubber linings are presented. The influence of the stability against chemical attack on the decontamination characteristics is discussed. Finally, it is pointed out that, since contamination is to be expected much more frequently than radiation damage in most nuclear facilities and radiochemical laboratories, the testing of materials for decontamination characteristics must receive preference to that for radiation resistance. (auth)

51170 PENETRATION OF THE WALL OF A SEALED ENCLOSURE. Jossoud, Michel (to Commissariat a l'Energie Atomique). French Patent 2,070,437. 16 Aug 1971. Filed 4 Dec 1969. (In French).

In order to perform manipulations in a sealed enclosure such as a glove box or cell, it is necessary to penetrate the enclosure wall with the appropriate device. A means of accomplishing this penetration which protects the wall against thermal and mechanical stresses transmitted from the device is described. A supporting sleeve passes through an orifice in the enclosure wall. Two insulation rings are fitted over this sleeve at different positions in the wall. A flange is provided parallel to the wall. A threaded disk is used in the tightening of the insulation rings between the wall and flange and disk. (France)

51171 HANDLING OF ^{133}Xe DISSOLVED IN SALINE. Abdel-Daymen, Hussein Mahmoud (Veterans Administration Hospital, Buffalo). Radiology; 103: No. 1, 208-9(Apr 1972).

An economic way of storing glass syringes of injectable ^{133}Xe for several days in a refrigerator is described. About 1% leakage per day is recorded. A three-way connection allows multiple doses to be drained from the stock syringe immediately before injection, thus achieving injection of up to 97% of the dose. (auth)

51172 CENTRAL CONTAINER FOR INDUSTRIAL GAMMA RADIOGRAPHY. Kiric, M.; Mrda, D. Zavarivac; 15: No. 4, 10-13(1970). (In Serbo-Croatian).

A container, designed for the storage of radioisotopes used for gamma radiography, is described. The radiation shielding design permits storage of large quantities of ^{192}Ir and, with slight modification, storage of large quantities of ^{60}Co. The container is handled manually. Automation of the procedure is possible. (auth)

Transportation

51173 (ORNL-TM-3934) DEVELOPMENT AND TESTING OF A CONNECTOR FOR REMOTE HANDLING OF HIGH-LEVEL WASTE CONTAINERS. Preston, M. K. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 18p. Dep. NTIS.

The design for a connector that can be used in the remote handling of high-level waste containers at spent-fuel reprocessing plants and a repository was developed at Oak Ridge National Laboratory. A prototype connector was fabricated and has been subjected to preliminary cyclic and strength tests. These tests were conducted for 4000 cycles with no load and approximately 16,000 cycles with load, and the results indicate that the connector exceeds the basic safety and load criteria. Further testing of the connector is planned to further evaluate its remote operating capabilities, its underwater operation, and the effects of heat on its performance. (auth)

51174 (UCRL-51271) ANALYSIS OF NEUTRON SHIPPING CASK, MODEL 0.5T. Hanson, C. L.; Coops, M. S. (California Univ., Livermore. Lawrence Livermore Lab.). 31 Mar 1972. Contract W-7405-eng-48. 18p. Dep. NTIS.

The analysis has been submitted to AEC/DOT to certify the Lawrence Livermore Laboratory shipping cask for safe transport of 5000 Ci quantities of alpha activity (nonfissile) in solid form. A typical shipment consists of 10 g of curium 244. The cask has been designed to meet the requirements found in AEC Manual, Chapter 0529. It also conforms to DOT standards and the Department has issued a special permit (6166) approving the design. The shielded neutron shipping cask weighs 1890 lb, has a diameter of 27.5 in. and is 36 in. long. The cask has a removable center plug and O-ring sealed cover plate. The center storage cavity has a diameter of 3.25 in. and is 10.5 in. deep. A special form container will be used on all shipments and is included as part of the shipping cask assembly. The cast spodumene aggregate serves as a neutron and gamma shield. The water contained in the aggregate is a moderator for degrading fast neutrons. (P.C.H.)

51175 FINNED TYPE COOLING ELEMENTS. Blum, Paul (to Transnucleaire, Societe pour les Transports de l'Industrie Nucleaire). French Patent 2,085,189. 24 Dec 1971. Filed 14 Jan 1970. (In French).

Finned type cooling elements for cylindrical shaped assemblies (principally for packing intended for the storing and transporting of radioactive materials) are presented. They consist of metallic fins welded to the outer shell of the packing and parallel to its axis. These fins are provided with a series of teeth on their outer free edge connected on one side to the fins. These teeth are twisted in such a way that their plane parts are situated in successive sensibly parallel planes perpendicular to the axis of the packing. (France)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 50370.

51176 (AD–737181) EXPERIMENTAL PROGRAMS WITH THE BRL TANDEM VAN DE GRAAFF AND COCKCROFT–WALTON ACCELERATORS. Annual Progress Report, March 1, 1970–February 28, 1971. Eccleshall, Donald; Van Antwerp, Walter R. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Dec 1971. 116p. (BRL-MR–2146). NTIS.

A second year of investigations with the BRL Tandem Van de Graaff has been completed. Research in several areas has been continued and, in most areas, some results are now available. This report presents these results, and it indicates actual or planned research in areas where results have not yet been obtained. Studies in neutron physics, Coulomb excitation, Moessbauer effect, charged-particle reactions, heavy-ion physics, nuclear structure, radiation chemistry, and radiation physics are discussed. During this second year, a major effort has been continued at the Tandem for facility development. These peripheral facilities are described in some detail for the benefit of potential users. Cooperative programs with universities and with other defense researchers are discussed. Also, the programs using the Cockcroft–Walton accelerator are presented. (auth) (GRA)

51177 (AD–739313) REPORT OF LINAC OPERATION. Interim Report No. 12, January 1–December 31, 1971. (Naval Research Lab., Washington, D. C.). Jan 1972. 29p. (NRL-MR–2402). NTIS.

The operation and use of the NRL 60-MeV Linac is described for the period January 1, to December 31, 1971. Highlights of the basic and applied research program are reviewed, including electron scattering, neutron-capture gamma-ray measurements, and a number of applications. Total time for the period was 3697 hours, divided into 2992 hours for beam and set-up time (including 302 hours for outside users), 560 hours devoted to maintenance and improvements, and 145 hours lost to breakdowns. A bibliography is included, as are brief descriptions of linac use by other groups. (auth) (GRA)

51178 (CONF-720717–3) PROPOSED NATIONAL HEAVY-ION ACCELERATOR AT OAK RIDGE. Martin, J. A.; Hudson, E. D.; Lord, R. S.; Mallory, M. L.; Milner, W. T.; Mosko, S. W.; Stelson, P. H. (Oak Ridge National Lab., Tenn.). [nd]. 9p. Dep. NTIS.

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

The proposed National Heavy-ion Laboratory will be provided with a multi-stage accelerator system integrated with the existing Oak Ridge Isochronous Cyclotron (ORIC) facilities. The main accelerator stage is to be a four-sector isochronous cyclotron that will provide beam energies up to 100 MeV/u. Ions may be injected into the large cyclotron from either a 20 MV tandem electrostatic accelerator or from the ORIC. The ion energies range from 100 MeV/u for oxygen to 10 MeV/u for uranium. Maximum beam intensities range from $\sim 10^{13}$ particles/second for oxygen to 2×10^{12} particles/second for uranium. The sector magnet angle for the cyclotron is 52° which yields radial and axial focusing frequencies of $\nu_r = 1.1$ to 1.2 and $\nu_z = 0.6$ to 0.8. The field-radius product of the magnet is 3018 kG-cm at a maximum magnetic field of 16 kG. The rf system is tunable over the range 6 to 14 MHz to accommodate acceleration on harmonics 2 to 11. Second harmonic resonators are provided to increase the phase acceptance and/or the energy resolution. (auth)

51179 (FRNC-R–12) ANNUAL REPORT, 1971. (Grenoble Univ. (France). Institut des Sciences Nucleaires). 1971. 141p. (In French). Dep. NTIS (U. S. Sales Only).

The latest modifications made to the cyclotron and its auxiliary equipment are described including the installation and initial operation of the beam analyzer magnets, detectors, targets and computers. It was possible to accelerate N^{4+} ions up to an energy of 97 MeV; 3rd harmonic operation was also attempted. The experiments effected during 1971 using the cyclotron are described including: spectroscopy using nuclear reactions, reaction mechanisms, and gamma ray beam spectroscopy. The incorporation of the isotope separator into the system was carried out during 1971: the 21 cm $\pi\sqrt{2}$ spectrometer was automated. Various level schemes were determined from radioactivity measurements. Studies carried out in collaboration with the CEN-Grenoble and the Laue–Langevin Institute are presented. Theoretical studies are examined independently. (France)

51180 (JAERI-Memo–4035) MATERIALS FOR PLANNING OF INSTALLATION OF A LARGE TANDEM ACCELERATOR. (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

A plan to install a large tandem accelerator at JAERI has been discussed by a JAERI working group of long-range planning in order to promote the research and development programs on atomic energy in the fields of nuclear physics, solid-state physics and nuclear chemistry. The group has recommended that the installation should be completed by 1975. A compilation of the materials which may be useful in making a proposal for installation of the tandem accelerator is given. The tandem accelerator itself, its peripheral equipments, and its building are described. In addition, an outline of big projects in U. S. with tandem accelerators is briefly reviewed. Also, some of the research plans in the fields of nuclear physics, solid-state physics, and nuclear chemistry are discussed. (auth) (Japan)

51181 (NP–19390) IPCR CYCLOTRON PROGRESS REPORT, 1971. Volume 5. (Institute of Physical and Chemical Research, Tokyo (Japan)). Dec 1971. 126p. Dep. NTIS (U. S. Sales Only).

Machine operation and machine development and accelerator physics are first described. Nuclear physics research on scattering and reactions and nuclear spectroscopy is recounted. Developments in nuclear instrumentation, radiochemistry, radiation chemistry and radiation biology, solid-state physics, radioisotope production and its applications, and radiation monitoring are discussed. Lists of publications and personnel are included. (R.W.R.)

51182 (UCRL-Trans–1474) STABILIZATION OF THE KINK-INSTABILITY OF A TWO-COMPONENT RELATIVISTIC RING BY AN AZIMUTHAL MAGNETIC FIELD. Bonch-Osmolovskii, A. G.; Reshetikova, K. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Univ. of California Lawrence Berkeley Lab., from Preprint JINR-P9-6136. 8p. Dep. NTIS.

The kink instability is considered in the presence of an azimuthal magnetic field, by means of a hydrodynamical model of two strings. It is shown that at sufficiently high values of the magnetic field the stability regions are essentially changed. In particular, the instability can be stabilized at significant beam densities. (2 figures) (auth)

51183 DOSE DISTRIBUTION AND STABILITY OF RADIOTHERAPY ELECTRON BEAMS FROM A LINEAR ACCELERATOR. Naylor, G. P.; Williams, P. C. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol.; 45: No. 536, 603-9(Aug 1972).

Dose distributions from radiotherapy electron beams of energy 3 to 10 MeV from the MEL SL75 Super Linear Accelerator were measured in unit density materials by ionization chamber and film dosimetry. The central axis percentage depth dose data are presented and compared for beams of various energies. The effect of field size is discussed and the method of producing and presenting isodose information is described. Contamination of the electron beam by x-rays in various situations is examined and methods of routinely checking the output energy and flatness of the electron beam are described. (auth)

Auxiliaries and Components

Refer also to abstracts 50731 and 51239.

51184 (AD–732433) DESIGN AND TESTING OF A CURRENT AND VOLTAGE MONITOR FOR HIFX. Sazama, Franklin J.; Stewart, Alexander G. (Harry Diamond Labs., Washington, D. C.). Aug 1971. 66p. (HDL-TR–1558). NTIS.

A kiloampere, pulse-current monitor and a megavolt, pulse-voltage monitor was built to characterize the performance of field-emission diodes on HDL's pulsed electron accelerator (HIFX). The monitors were calibrated under kilovolt-pulse conditions, using a specially developed coaxial circuit, and tested by making time-synchronized current and voltage measurements on a hemisphere-plane diode. The measured diode current and voltage pulses are consistent with waveform and bremsstrahlung output expectations for the accelerator. The initial anode-cathode gap impedances obtained from these measurements are in reasonable agreement with the gap impedance calculated from the Langmuir–Child three-halves power law for space charge limited diodes.

These findings indicate that the monitors are capable of measuring pulsed current and voltage waveforms with sufficient amplitude and timing accuracy to be useful in future field-emission diode studies. The monitors can provide a better understanding of those diode parameters that control electron energy and bremsstrahlung angular distribution. This understanding should permit the design of pulsed bremsstrahlung diodes that are capable of producing photons and electrons with greater or more desirable energies and spatial distributions. (auth) (GRA)

51185 (AEC-tr–7138, pp 165–70) EXPERIMENTAL STUDY OF SOME PARAMETERS OF HIGH-VOLTAGE CIRCUITS FOR NEUTRON-PULSE GENERATORS. Kir'yanov, G. I.; Portnov, L. A. Translated from Radiats. Tekh.; No. 3, (1969).

The problem of designing small-scale systems for the generation of neutron fluxes of 10^8 to 10^9 neutrons/s at accelerating voltage pulses of 100 to 150 kV requires a detailed study of the processes and a careful selection of the components for a circuit producing short accelerating voltage pulses. Circuits were analyzed theoretically and tested experimentally. The results showed that the computation of an accelerating voltage source involves, in essence, the determination of the capacitance of the reservoir capacitor and of the transformation ratio of the pulse transformer. Several solutions can be obtained. One should select that solution which can be used to obtain the required amplitude of the voltage pulse at the smallest possible transformation ratio, which determines the duration of the increase in the voltage pulse, and the lowest possible capacitance of the reservoir capacitor, which determines the thermal conditions for the pulse transformer. (5 figures) (R.W.R.)

51186 (CONF-720717–2) COMPUTER CONTROL SYSTEM FOR ORIC. Ludemann, C. A.; Domaschko, J. M.; Mosko, S. W. (Oak Ridge National Lab., Tenn.). [nd]. 8p. Dep. NTIS.

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

A computer control system is being implemented for the Oak Ridge Isochronous Cyclotron (ORIC). At the start of a run, operating parameters are set automatically using data stored in a disc library. Adjustments of these parameters are made through an operator-computer interface consisting of a CRT unit with a keyboard. An array of assignable push-button switches is available for fine tuning various machine parameters. ORIC has 43 ungrounded power supplies requiring adjustment resolution to within 1 part in 10^3 to 1 part in 10^5 depending upon their function. These supplies are controlled by reference voltages derived from 12- to 16-bit digital-to-analog converters (DAC's). A programmable comparator associated with each power supply relays information on power supply performance to the computer. The power supplies, DAC's, and comparators are isolated from the computer by optical couplings and blocking capacitors. The control system sets and fine tunes the rf system, monitors and controls binary functions, switches power supplies to required circuits, alerts the operator if any cyclotron parameter exceeds the specified limits, and processes and stores new run parameters. (auth)

51187 (LA-DC–72-780) NEW BEAM-SPILL CONTROL SYSTEM FOR LAMPF. Parker, J. R.; Richardson, J. H.; Easley, J. D. (Los Alamos Scientific Lab., N. Mex.). [nd]. 6p. (CONF-720717–4). Dep. NTIS.

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

The high-intensity beam of LAMPF requires careful control of beam loss to minimize activation of the beam channel. A beam-spill control system now in operation which limits the average beam loss to an amount allowed by activation criteria without severely restricting accelerator tune-up and diagnostics work is described. This average loss is maintained by downward modulation of the beam-pulse width and repetition rate until the loss-producing fault is corrected. Binary and analog signals describing the action are sent to the Central Control Computer where decisions regarding corrective measures can be made by either the operator or the computer. The computer can test all beam-spill monitors simultaneously while the machine is in operation. (auth)

51188 (ORNL-TM–3946) ORIC ADC SYSTEM. Goodman, C. D. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 19p. Dep. NTIS.

The multiparameter data acquisition system in use at the Oak Ridge Isochronous Cyclotron is described. The pulse stretchers, analog-to-digital converter, digital modules, controller, typical connections, and pile up rejection are discussed. (W.H.K.)

51189 (RPP/A–90) VERY HIGH FIELD SYNCHROTRON MAGNETS WITH IRON YOKES. Coupland, J. H.; Simkin, J.; Randle, T. C. (Rutherford High Energy Lab., Chilton (England)). Jul 1972. 27p. Dep. NTIS (U. S. Sales Only).

A variety of dipole and two quadrupole magnets were studied using the computer. All the magnets had iron yokes in close association with the windings. Conclusions are drawn about the error fields in the useful aperture arising from saturation in the yoke. Shaping the iron enables the saturation to be controlled. Magnets were designed with errors small enough for use in proton synchrotrons with fields up to 6.0 Tesla. (auth) (UK)

51190 (SLAC-PUB–975) MEASUREMENTS AT SLAC ON SUPERCONDUCTING NIOBIUM CAVITIES AND STRUCTURES. Wilson, P. B.; Allen, M. A.; Deruyter, H.; Farkas, Z. D.; Hogg, H. A.; Hoyt, E. W.; Martin, H. L.; Rabinowitz, M. (Stanford Linear Accelerator Center, Calif.). Oct 1971. 5p. (CONF-710908–11). Dep. NTIS.

From 8th international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

Tests are continuing at SLAC on superconducting niobium cavities and structures at S- and X-band frequencies. Peak electric and magnetic fields on the order of 20 Mv/m and 400 G have been obtained in a TM mode cavity at 2.85 GHz with unloaded Q's at high fields on the order of 10^{10}. These fields and Q's are adequate for superconducting RF systems for high energy storage rings and recirculating linear accelerators. (auth)

51191 (SLAC-PUB–977) NIOBIUM SURFACES FOR RF SUPERCONDUCTORS. Hoyt, E. W. (Stanford Linear Accelerator Center, Calif.). Oct 1971. 9p. (CONF-711045–1). Dep. NTIS.

From 5th international vacuum congress; Boston, Mass. (11 Oct. 1971).

Recent research in the processing of niobium surfaces for use in superconducting electron linacs and rf particle separators is outlined. Also, results of preliminary measurements which indicate that hydrogen sorption is responsible for much of the scatter in the superconducting cavity measurements are discussed. (29 references.) (W.H.K.)

51192 GROUNDED MONITOR FOR HIGH VOLTAGE ACCELERATORS. Crockett, C. G. (Edwards High Vacuum International, Crawley, Eng.). J. Phys., E (London); 5: No. 8, 753-4 (Aug 1972).

A simple apparatus is described which is used to monitor equipment in the high voltage terminal of a particle accelerator, and display the reading on a meter at ground potential. A servo mechanism is used to rotate an insulating rod coupled to a grounded potentiometer. The system, while being relatively inexpensive, provides an accuracy better than 1%. (auth) (UK)

Ion Sources, Injection, and Extraction

Refer also to abstracts 50725, 51204, and 52146.

51193 (CEA-R–4309) DEVELOPMENT OF AN EMITTANCEMETER SUITABLE FOR USE WITH A HIGH FREQUENCY DISCHARGE ION SOURCE. MEASUREMENT OF THE CHARACTERISTICS OF THE EXTRACTED BEAM. Delahaye, Jean-Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1972. 204p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Grenoble Univ. (France). Faculte des Sciences.

The design and operation of an emittancemeter of a very high sensibility that allows the accurate and complete analysis of an ion or electron beam in two different planes next to the outlet of the source are described. This apparatus is used to study a radiofrequency ion source. An extraction model especially adapted to the geometrical and electrical conditions of this source account for the qualitative and quantitative incluence of the main parameters on the characteristics of the extracted beam. (auth)

51194 (CONF-720717–1) ORIC AS A HEAVY-ION INJECTOR FOR A SEPARATED SECTOR CYCLOTRON. Hudson, E. D.; Lord, R. S.; Mallory, M. L.; Stelson, P. H. (Oak Ridge National Lab., Tenn.). [nd]. 9p. Dep. NTIS.

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

The characteristics of the Oak Ridge Isochronous Cyclotron (ORIC) for the injection of heavy-ions into a separated sector cyclotron have been studied and found to be excellent. With a carbon foil between the accelerators, the output energy of the ORIC is sufficient to give a stripped ion beam at least twice the charge state of the ORIC's extracted beam up to mass 200.

This allows an ideal magnetic field match to a separated sector cyclotron with a magnet fraction of 0.58. The 37-MeV $^{40}Ar^{4+}$ beam from the ORIC was used to test the lifetime of 20-μg/cm^2 carbon foils. It was found that the stripping characteristics were unchanged after a total transmission of 5×10^{17} particles per cm^2. Results of the measurement of the ORIC beam loss as a function of pressure in the cyclotron tank and beam line are also presented. (auth)

51195 (INS-TH-72) ELECTRON BEAM DEBUNCHING WITH RF PERTURBATIONS. Fukushima, Toshitaka; Katayama, Takeshi; Yamakawa, Tatsuya; Yamaguchi, Seitaro (Tokyo Univ. (Japan). Inst. for Nuclear Study). 14 Dec 1971. 25p. NTIS (U. S. Sales Only).

A method of lengthening the beam spill time with rf perturbations is devised for the 1.3 GeV electron synchrotron at the Institute for Nuclear Study, Tokyo (INS ES). The rf carrier wave of 137.989 MHz is modulated both in frequency and in amplitude to produce the perturbations. With the use of frequency modulation the electron beam uniformly falls out from the stable region in the synchrotron oscillation's phase space. In this case the electron beam may be considered to undergo the first order parametric resonance and the FM frequency may be equal to twice the synchrotron oscillation's frequency of the particle which moves near the boundary of the stable region (Separatrix). It is necessary to detune the accelerating cavity to the lower frequency side by at least 25 kHz to obtain the fine beam spill debunching when the intensity of the circulating current is larger than several mA. (auth) (Japan)

51196 (RPP/E-18) ULTRA-THIN SEPTUM MAGNET. Mortimer, A. R.; Gresham, A. T. (Rutherford High Energy Lab., Chilton (England)). Jun 1972. 12p. Dep. NTIS (U. S. Sales Only).

An improved current-carrying ultra-thin septum magnet for beam extraction is described. It is stated that magnets of any practical length can be made with septums as thin as 0.5 mm. Cooling is by water flowing in very small bore pipes arranged transversely within the septum, and connected to longitudinal water manifolds. Turbulent flow is necessary to achieve good heat transfer. Exploratory work which was undertaken to define the optimal design conditions for water flow and heat transfer is reported. A design of an operational magnet is proposed, using electron beam techniques to provide a thin ceramic insulation to the water cooling pipes. (U.K.)

51197 FIELD OF A SYSTEM CONSISTING OF SLITS AND THICK ELECTRODES WITH RECTANGULAR APERTURES. Afanas'ev, V. P. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 246-53(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 309-19(Feb 1972).

A rapid convergence method is proposed for calculating the field in a wide class of two-dimensional electron-optics systems; the method is based on an expansion of the potential at each slit in a series in terms of a complete orthonormal system of functions. Two examples are given to illustrate the method: that of a three-electrode system with a thick central electrode and that of a system corresponding to an ion source. The results found in the calculation for the second example are compared with known experimental data. (auth)

51198 ELECTRON BEAM OF A BETATRON WITH HIGH-VOLTAGE INJECTION. Kononov, B. A.; Evstigneev, V. V.; Savel'ev, B. F. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 136-7(1972). (In Russian).

The extracted electron beam from the vacuum chamber of a 10-MeV betatron was used as a Kerst-type injector with voltages up to 50 kV, and also with high-voltage injection up to 150 kV. An electrostatic method of extraction resulted in two paths. A comparison of the accelerated charge of electrons with different injectors indicated that the dependence of the electron flux density on the radial placement of the deflector was identical. The dimensions of the beam at the exit from the acceleration chamber were 25 × 5 mm; this and other parameters indicated that the beam is capable of further focusing without undue loss of its intensity. (K.S.W.)

Ion Optics and Field Calculations

51199 (AREAEE-117) PROPERTIES OF EDGE FOCUSING BENDING MAGNET SYSTEM. Abdel-Salam, F. W. (Atomic Energy Establishment, Inshas (Egypt)). 1971. 16p. INIS.

Convenient matrix calculations for edge focusing bending magnets in the horizontal and vertical cases are presented. Equations for Q-pole lenses and for edge focusing bending magnets are given. The parameters of magnet systems such as object and image distances, focal lengths and magnifications are given to calculate the resulting momentum dispersion and beam trajectories. (INIS)

51200 (AREAEE-118) STUDY OF THE PROPERTIES OF MAGNETIC FOCUSING SYSTEMS. Abdel-Salam, F. W. (Atomic Energy Establishment, Inshas (Egypt)). 1971. 27p. INIS.

The characteristics of a system consisting of a bending magnet and a quadrupole lenses in both horizontal and vertical cases and in which the field index n is equal to one and more than one are studied. The general case for a magnetic system using matrix calculations is given. The procedure for obtaining the parameters of a bending magnet are presented. (INIS)

51201 (CONF-710964-, pp 47-59) ANALYSIS OF PARASITIC MULTIPOLE FRACTIONS IN A MULTIPOLE FIELD OF DESIGNED ORDER BY INCREMENTAL FIELD MEASUREMENT WITH A HALL PROBE. Jung, V. (Kernforschungszentrum, Karlsruhe, Ger.). 1971.

From third Reno conference on magnetic fields; Reno, NV. (2 Sep 1971).

The field strength in an ideal multipole field is $B(r) = c \cdot r^{p/2-1}$, where p is the multipole order and r the distance from the neutral axis. It is possible to check the constancy of the field value at the distance r from the axis by means of a Hall probe, if the probe which is led on a circle around the neutral-field axis follows the given direction of the designed field also by rotation around its own axis. The two movements are coupled in a program-controlled measuring machine in which an adjusting device aligns the sensitive axis of the probe with its axis of rotation. The respective admixtures of parasitic multipoles can be analyzed from the fluctuation of the field value along the circle traversed. (auth)

51202 (INS-TL-113) COMPUTER PROGRAM FOR BEAM OPTICAL SYSTEMS. Tanabe, Tetsumi (Tokyo Univ. (Japan). Inst. for Nuclear Study). 2 Aug 1971. 38p. (In Japanese). INIS.

A computer program, TRAMP, for the beam optics was translated into Fortran code for the TOSBAC-3400 computer in INS. The program tracks particle trajectories and beam ellipses in phase space through systems of quadrupoles, bending magnets and velocity separators, and also adjusts quadrupole field gradients or drift lengths in order to obtain desired beam conditions. The constitution of the program and the information concerning data input are described with an example of beam design. (auth)

51203 (LA-4967) RELATIVISTIC CHARGED-PARTICLE BALLISTICS IN CONSTANT, UNIFORM ELECTROSTATIC AND MAGNETIC FIELDS. Everett, C. J.; Cashwell, E. D. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 10p. Dep. NTIS.

The trajectory of a charged particle with arbitrary initial position and velocity is completely determined in the presence of constant uniform fields of the following types: (1) pure electrostatic, (2) pure magnetic, and (3) electrostatic and magnetic fields superimposed, in parallel, perpendicular, and arbitrary orientation. The treatment, which is relativistic throughout, was motivated by recent Monte Carlo studies of electron transport involved in laser design, and is supplemented by computational methods. Radiation losses are not considered. (auth)

51204 COUNTER ELECTRON-POSITRON BEAMS IN A SYNCHROTRON. Ado, Yu. M.; Belovintsev, K. A.; Bessonov, E. G.; Cherenkov, P. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 130-48(1971). (In Russian).

The possibility of producing counter electron-positron beams in synchrotrons was investigated. The effect of low energy levels of injection and of the fluctuating character of the magnetic field on the fundamental parameters of the process of build-up of particles was ascertained. Results on the production of counter electron-positron beams and the investigation of build-up with the 280-MeV cyclotron are discussed. Russian and foreign attempts to utilize the cyclotron method at 1 GeV energy and higher are described. (tr-auth)

51205 THEORY OF COMPOUND CYLINDRICAL ELECTRON MIRRORS. II. Kel'man, V. M.; Fedulina, L. V.; Yakushev, E. M. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 238-41(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 297-302(Feb 1972).

The dispersion of a compound cylindrical electron mirror and its second-order geometric aberrations have been calculated for an image perpendicular to the median plane of the mirror. (auth)

Storage Rings

Refer also to abstracts 50693, 50694, 50725, and 50726.

51206 (BNL–16786) RIBBON DISTRIBUTION IN COS θ DIPOLE OF 8-CM APERTURE. Dahl, P. F.; Morgan, G. H.; Sampson, W. B. (Brookhaven National Lab., Upton, N. Y.). 27 Apr 1972. 10p. Dep. NTIS.

The distribution of ribbon conductors for the projected 8-cm id cos θ model superconducting dipole magnet is summarized. Calculated field distributions and Fourier components for the case of an infinite μ iron shield are given, and conductor placement tolerances are discussed. (3 figures, 2 tables) (auth)

51207 (BNL–16809) REFLECTIONS ON BNL SPIRIT OF '76. Pais, A. (Brookhaven National Lab., Upton, N. Y.). 17 Sep 1971. 5p. Dep. NTIS.

Reasons for pursuing the ISABELLE project at BNL are briefly discussed. Topics include scientific aspects, ISABELLE as a pilot project for industry, storage rings and the U. S. high energy programs, and financial aspects. (W.H.K.)

51208 (BNL–16811) VACUUM SYSTEM PARAMETERS FOR ISABELLE. Grand, P. (Brookhaven National Lab., Upton, N. Y.). 4 Nov 1971. 7p. Dep. NTIS.

Parameter requirements for the preparation of a conceptual design for the vacuum system for ISABELLE are discussed. The operating pressure, outgassing rate, clean walls, leaks, pumping speeds, type of pumps, the vacuum chamber and associated hardware, and the measurement of pressure are discussed. (W.H.K.)

51209 (BNL–16812) ALTERNATE BEAM STACKING AND RF PARAMETERS FOR ISABELLE. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 9 Nov 1971. 9p. Dep. NTIS.

A proposed beam stacking procedure for ISABELLE is outlined. Also, equations are given for cavity detuning by the beam when beam bunching occurs before acceleration starts. (W.H.K.)

51210 (BNL–16813) FUTURE POSSIBILITY WITH ELECTRON–PROTON, ELECTRON–POSITRON, AND PHOTON–PHOTON COLLIDING BEAMS. Muzinich, I. J. (Brookhaven National Lab., Upton, N. Y.). 8 Nov 1971. 7p. Dep. NTIS.

Electron–proton storage rings are emphasized as an option for the ISABELLE facility. It is, of course, the primary motivation of the effort to build proton-proton storage rings; however, in case time and financial resources become available, the interesting type of Physics that is also possible with electron proton rings is stressed. (auth)

51211 (BNL–16814) RF ACCELERATING CAVITIES FOR ISABELLE. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 19 Nov 1971. 6p. Dep. NTIS.

Design parameters for rf accelerating cavities for ISABELLE are listed and briefly discussed. (W.H.K.)

51212 (BNL–16819) MAGNET POWER SOURCE FOR ISABELLE. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 29 Nov 1971. 10p. Dep. NTIS.

Parameters are tabulated for bending magnets with apertures of 50.8, 57.2, and 63.5 mm. A schematic diagram of the power circuit that may be used in bending magnets for ISABELLE is given. Ripple filtering is accomplished by a combination of the effects of the passive filter, and a feedback system that controls the firing of the SCR rectifiers. The raw ripple, the attenuation that results from the two filtering systems, the resulting ripple voltage, and the ratio ΔI/I for the ripple current in the bending magnet system are tabulated for nine frequencies ranging from 60 to 2880 Hz. (W.H.K.)

51213 (BNL–16820) ALTERNATE ACCELERATING SYSTEM FOR ISABELLE. Plotkin, M. (Brookhaven National Lab., Upton, N. Y.). 30 Nov 1971. 4p. Dep. NTIS.

The desirable features of an accelerating system using a drift tube cavity, as opposed to a ferrite-loaded cavity, are described. Instead of a ferrite structure, one must cool a resistor, which can be specifically designed for the purpose. (R.W.R.)

51214 (BNL–16821) ISABELLE VACUUM SYSTEM. Grand, P. (Brookhaven National Lab., Upton, N. Y.). 7 Dec 1971. 11p. Dep. NTIS.

Techniques to reach very low ultimate gas loads for the pumping system for ISABELLE are described, and appropriate parameters are given. Desorption of gas by ion bombardment remains a problem, as no practical technique is available to clean the walls of strongly bound molecules. However, problems of ion bombardment can be reduced by taking advantage of the cryogenic temperature present to lower the pressure in the system by orders of magnitude if H and He gases can be kept out. This makes it desirable to operate the beam pipe, including the straight sections, at 4°K. (1 figure) (R.W.R.)

51215 (BNL–16822) PRELIMINARY THOUGHTS ON SURVEYING. Lasky, C. (Brookhaven National Lab., Upton, N. Y.). 9 Dec 1971. 5p. Dep. NTIS.

Limited allowance for orbit distortions due to quadrupole placement errors dictates a first-order survey of the primary monument system. The method suggested involves measurements of distances and angles formed by the intersections of lines between monuments by using constant-tension, constant-temperature Invar tapes, although other methods will be considered. Procedures for making the required measurements are described. (R.W.R.)

51216 (BNL–16824) VERTICAL BEAM STACKING IN ISABELLE. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 10 Dec 1971. 8p. Dep. NTIS.

The principles around which the proposed method of beam stacking is generated are listed, and an arrangement of apparatus to accomplish this is given. The sequence of events during beam stacking is described. Design parameters for kicker magnets are included. (3 figures) (R.W.R.)

51217 (BNL–16825) MEASUREMENT OF PP TOTAL CROSS SECTIONS IN ISABELLE. Carroll, A. S. (Brookhaven National Lab., Upton, N. Y.). 7 Dec 1971. 8p. Dep. NTIS.

The measurement of p + p total cross sections in ISABELLE colliding beams is discussed. Three methods are considered: (1) measurement of the attenuation of the circulating beams due to the beam–beam collisions, (2) use of the optical theorem and extrapolation of the elastic differential cross section to 0°, and (3) detection of all interactions from beam–beam collisions. The general experimental layout for method (3) is given, and it is concluded that this measurement method should have a precision of approximately 1%. (W.H.K.)

51218 (BNL–16826) SUPERPERIODS IN HIGH ENERGY STORAGE RINGS. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 27 Dec 1971. 4p. Dep. NTIS.

A simple qualitative picture to provide a guide for the choice of the number of straight sections, or of the superperiods, in the ISABELLE storage rings is presented. This picture suggests that, in order to have only two long straight sections, or a superperiod of 2, one may be required to reduce the ν value to $\nu = 9.25$ from the present choice of $\nu = 17.25$. If four long straight sections are tolerable, for a superperiod of 4, then a ν value of $\nu = 13.75$ may be acceptable. These results are based on a proposed criterion that no stopbands should occur within the working aperture of the accelerator. (1 figure) (R.W.R.)

51219 (BNL–16832) ISABELLE WITH WARM MAGNETS. Courant, E. D. (Brookhaven National Lab., Upton, N. Y.). 7 Feb 1972. 4p. Dep. NTIS.

Orbit parameters for ISABELLE are calculated for the case of conventional magnets. It is found that an ISA facility using such magnets is feasible. (1 table) (R.W.R.)

51220 (BNL–16833) UPDATED LIST OF PARAMETERS FOR ISABELLE. Chasman, R. W.; Courant, E. D.; Month, M.; vanSteenbergen, A. (Brookhaven National Lab., Upton, N. Y.). 8 Feb 1972. 21p. Dep. NTIS.

The general parameters, regular lattice structure, orbit parameters, magnet aperture subdivision for the regular lattice structure, injection straight section parameters, and long straight section parameters are listed. (W.H.K.)

51221 (BNL–16834) DIFFERENTIAL CONTRACTIONS OF ISABELLE MAGNET COMPONENTS. Lasky, C. (Brookhaven National Lab., Upton, N. Y.). 8 Feb 1972. 4p. Dep. NTIS.

For the 3.2-m dipole presently proposed for ISABELLE there will be about 0.125 in. differential contraction between a low carbon steel core and the superconducting windings. Since a tight fit between the coil and the inside bore of the core is considered necessary to prevent motion of the conductors in the magnetic field, this differential motion must either be restrained or eliminated. It is shown that the differential motion can be minimized by the use of stainless steel welding straps and a careful selection of the stacking pressure. (R.W.R.)

51222 (BNL–16835) ISABELLE VACUUM CHAMBER. Bittner, J.; Grand, P. (Brookhaven National Lab., Upton, N. Y.). 8 Feb 1972. 8p. Dep. NTIS.

The vacuum requirement for ISABELLE are summarized, and additional factors to be considered in the design of the vacuum chamber including the beam effect and the thermal effect are discussed. Two possible designs for the chamber which use different approaches in the bakeout scheme and in obtaining the copper surface are briefly described. One design uses electrodeposition to deposit the inner copper surface and uses wrapped nichrome tape for bakeout. The other design uses an inner copper pipe and helium gas is used as the heating medium for bakeout. The latter design will be proposed by the authors for ISABELLE. (W.H.K.)

51223 (BNL-16836) COMPUTED AND EXPERIMENTAL RESULTS FOR THE 14-IN. MODEL. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 10 Feb 1972. 3p. Dep. NTIS.

Experimental results and computed results from the GRACY program and the LINDA program for the 14-inch model bending magnet are tabulated and compared. GRACY and LINDA results agree quite well but do not agree with experimental results. It is suggested that there is an error in the input to the programs (such as the $B-\mu$ table), or there is something physically going on which is not understood. (W.H.K.)

51224 (BNL-16838) PHYSICS AT ISABELLE. Marx, Jay (Brookhaven National Lab., Upton, N. Y.). Jan 1972. 8p. Dep. NTIS.

A summary of the high-energy physics possibilities at ISABELLE is presented. The options possible with the proposed ISABELLE project include $p+p$ colliding beams, conventional 200-GeV physics, $d+d$ and $d+p$ colliding beams, e^-+p colliding beams, $\bar{p}+p$ colliding beams, e^++p colliding beams, and $e^++\bar{p}$ colliding beams. (W.H.K.)

51225 (BNL-16839) INTERSECTING STORAGE RINGS FOR STUDYING INTERACTIONS AT VERY LOW ENERGIES. Kalogeropoulous, T. E. (Brookhaven National Lab., Upton, N. Y.). 22 Feb 1972. 8p. Dep. NTIS.

It is suggested that Intersecting Storage Rings can be used for studying the very low center-of-mass energy region of two interacting particles, which is unaccessible by present experimental techniques. It is further suggested that the next generation of the proton-proton storage rings is suitable for studying antiproton-proton annihilations at very low energies. (auth)

51226 (BNL-16840) PERTURBATION METHOD FOR COS θ MAGNET WITH NONLINEAR IRON. Hahn, H. (Brookhaven National Lab., Upton, N. Y.) 3 Mar 1972. 16p. Dep. NTIS.

A first order perturbation method for describing the magnetic field in a dipole magnet with nonlinear iron shielding is presented. (W.H.K.)

51227 (BNL-16843) ISABELLE VACUUM PUMPING SYSTEM. Grand, P. (Brookhaven National Lab., Upton, N. Y.). 27 Mar 1972. 26p. Dep. NTIS.

The proposed general layout for the ISABELLE vacuum pumping system is described. The system will have to undergo three modes of operation: 300°C bake condition, ultrahigh vacuum operation at room temperature, and ultrahigh vacuum operation at 4.5°K. The use of cryosorption pumping to achieve the required operating pressure of $<10^{-10}$ torr is proposed, and a pump design to meet this requirement is described. (7 figures) (R.W.R.)

51228 (BNL-16844) SEVEN BLOCK COIL CONFIGURATION FOR A COSINE BENDING MAGNET. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 29 Mar 1972. 7p. Dep. NTIS.

A coil configuration for a cosine bending magnet wound out of a ribbon type conductor is described. The corrected fields and required azimuthal displacements for corrections are given for a dipole having seven blocks in a quadrant and 1) a total of 71 ribbon turns with a ribbon distribution of 15, 14, 13, 11, 9, 6, and 3 and 2) a total of 56 ribbon turns with a ribbon distribution of 12, 11, 10, 9, 7, 5, and 2. The ribbon was $^5/_8$ of an inch wide and 0.0261 of an inch thick. (W.H.K.)

51229 (BNL-16845) MAGNETIC FORCES IN THE SIX-BLOCK ISABELLE MAGNET. Morgan, G. H. (Brookhaven National Lab., Upton, N. Y.). 30 Mar 1972. 4p. Dep. NTIS.

The magnetic forces on each block in the first quadrant of the six-block ISABELLE magnet are tabulated as computed by program MAGFLD for the infinite μ case. Also, magnetic forces for a proposed design involving a vertical split of the iron are calculated. (W.H.K.)

51230 (BNL-16846) OPTION FOR 200 GeV PHYSICS AT ISABELLE. Wang, C. L. (Brookhaven National Lab., Upton, N. Y.). 8 Mar 1972. 17p. Dep. NTIS.

The radiation safety aspects of bringing ISABELLE secondary beams to the AGS experimental area to utilize the existing facilities are discussed. The general layout of ISABELLE, the target stations and secondary beams; the parameters and components of secondary beams, and cost estimates are briefly discussed. Since bringing the secondary beams back to the experimental area means directing high energy radiation (particularly highly penetrating muons) toward populated areas, it is recommended to not direct ISABELLE secondary beams into the AGS experimental area. (W.H.K.)

51231 (BNL-17017) LONG-RANGE BEAM-BEAM INTERACTION OF CROSSING BEAMS. Keil, E.; Pellegrini, C.; Sessler, A. M. (Brookhaven National Lab., Upton, N. Y.). 26 Jun 1972. 12p. Dep. NTIS.

The linear tune shift of a particle crossing an azimuthally uniform cylindrically symmetric Gaussian beam is evaluated; the β variation through the crossing region is taken into account. (1 figure) (auth)

51232 (BNL-17018) ON THE IMPORTANCE OF USING LIGHT (AND HEAVY) NUCLEI AS TARGETS. Walker, W. D. (Brookhaven National Lab., Upton, N. Y.). 1972. 4p. Dep. NTIS.

The advantages of using particles other than protons in the Intersecting Storage Accelerator (ISA), subsequent to the study of $p-p$ interactions, are discussed. The exchange in $p+d$ and $p+\alpha$ interactions should be dominated by $I=0$ and $I=0$, $S=0$, respectively. $p+{}^3He$ reactions have form factors similar to the above, but isovector exchanges are operative. Baryons of 100 GeV mass could be produced. In addition, electromagnetic effects could be studied if heavier nuclei are accelerated. (R.W.R.)

51233 (KHFTI-71-33) EFFECT OF ELECTRODYNAMIC INTERACTION OF PARTICLES ON THE LONGITUDINAL DIMENSIONS OF A CLUSTER OF ELECTRONS IN AN ACCUMULATOR. Grigor'ev, Yu. N.; Grishaev, I. A.; Kononenko, S. G.; Mocheshnikov, N. I.; Naugol'nyi, N. N.; Reprintsev, L. V.; Shenderovich, A. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The effect of electrodynamic forces of interaction of electrons was examined with regard to the screening effect of the metallic vacuum chamber on the phase motion of electrons in an accumulator. A decrement of synchrotron oscillations was computed for small phase oscillations in the assumption of a quasi-stationary distribution of electrons in the accumulated cluster. With an increased number of accumulated particles the decrement of synchrotron oscillations of discrete particles decreased. The result of the action of quantum fluctuations in radiation lead to an increase in the longitudinal dimensions of the cluster in the accumulator. (K.S.W.)

51234 (LNF-72/24) INJECTION SYSTEM OF ADONE. Fascetti, M.; Massarotti, A.; Papitto, P.; Puglisi, M.; Tazzioli, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 20 Mar 1972. 16p. Dep. NTIS (U. S. Sales Only).

The beam injection system that has been used at Adone for more than one year is described. The injector consists of two closed deflectors and a bumper coil that perturbs the closed orbit temporarily. The bumper coil, deflectors, pulse forming networks, and commands and controls are described. (W.H.K.)

51235 (SLAC-PUB-965) SLAC STORAGE-RING PROJECT: SPEAR. (Stanford Linear Accelerator Center, Calif.). Sep 1971. 4p. (CONF-710908-10). Dep. NTIS.

From 8th international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

The SLAC positron-electron storage ring SPEAR is a single ring comprising two superperiods and having two interaction regions. It will operate initially at energies up to 2.5 GeV and at luminosities up to about 10^{32} cm^{-2} sec^{-1}. The main features of the design, including the magnet system, the vacuum system, the radiofrequency system, the injection system, and the computer-based instrumentation and control system, are briefly described. Initial operation of SPEAR is scheduled for April 1972. Options for future improvement of the storage ring, which include raising the beam energy as high as 4.5 GeV and adding a second intersecting storage ring, are also discussed. (auth)

51236 (UCRL-Trans-1475) STABILITY OF A BUNCHED BEAM INTERACTING WITH MATCHED LINES. Derbenev, Ya. S.; Dikanskii, N. S.; Pestrikov, D. V. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Univ. of California Lawrence Berkeley Lab., from preprint IYaF 7-72. 66p. Dep. NTIS.

The collective stability of a bunched beam interacting with a matched line is investigated. Expressions are obtained for the decrements (increments) of betatron and synchrobetatron excitations of an arbitrary multipole order as functions of characteristic parameters of the problem (plate length, bunch length, and chromatism). (4 figures) (auth)

51237 TWO KILOMETERS AT 10^{-10} TORR. THE CERN INTERSECTING STORAGE RINGS FOR PROTONS. Fischer, E. (CERN, Geneva). J. Vac. Sci. Technol.; 9: No. 4, 1203-8(1972).

The Intersecting Storage Rings (ISR) in Geneva are a new research facility for experiments with colliding proton beams of energies of up to 28 GeV and intensities of up to 20 A. The ISR vacuum system consists of two interlacing doughnuts formed by elliptical pipes 160×50 mm and circular pipes of 160 mm diameter, of a total length of 2 km. The chambers are made out of stainless steel and can be baked in situ at 200 to 300°C. An average pressure of 10^{-10} torr has been attained. This is necessary in order to achieve the required beam life of several days. At the intersecting regions where the proton–proton collisions are being observed and where proton–gas collisions produce a disturbing background, equivalent nitrogen pressures of 10^{-11} torr are required and have been actually achieved. The construction, commissioning, and operation of this vacuum system are reported. (auth)

Experimental Facilities

Refer also to abstracts 50637 and 51982.

51238 (AEC-tr–7138, pp 71-84) COMPARATIVE EVALUATION OF THE RELIABILITY OF NEUTRON PULSE GENERATORS. Kir'yanov, G. I.; Konevets, B. G. Translated from Radiats. Tekh.; No. 3, (1969).

The calculation of the reliability of an electronic system comprising N chains connected in parallel with each chain comprising n modules is discussed; regeneration of the chains is taken into account. The dependence of the reliability of a system on the number of modules in the system for various methods of defect location and recovery of the lost functions is found, as well as the relation between the recovery time of a system and the number of modules it contains. The theoretical framework developed was used to compare the reliability of four commercially available neutron pulse generators—NGI-1, NGI-4, NGI-5, and NGI-6. (4 figures, 2 tables) (R.W.R.)

51239 (AEC-tr–7138, pp 159-65) EXPERIMENTAL INVESTIGATION OF THE STATISTICAL CHARACTERISTICS OF THE YIELD PARAMETERS OF VACUUM-TUBE NEUTRON-PULSE GENERATORS. Kir'yanov, G. I. Translated from Radiats. Tekh.; No. 3, (1969).

The effect of fluctuations in the accelerating voltage and in the current through the tube on the variation in the neutron yield per pulse was evaluated by investigating the fluctuation in the amplitude of the accelerating voltage with and without a real load (the tube), as well as the current of accelerated particles in a pulse. The statistical characteristics were studied for the case of continuous operation of a neutron generator of the NGI type. The results show that the nature of the amplitude distribution remains practically unchanged when the amplitude of the accelerating voltage is varied within 20%. Switching on the accelerating tube load increases the scatter in the amplitudes of the accelerating voltage by a factor of about 3. Thus, in an operating neutron generator of the NGI type with an isolated commutator, the fluctuations in the accelerating voltage can reach 5%; then the measured fluctuation in the neutron yield per pulse is 44%. The fluctuations in neutron yields from one pulse to another are determined mainly by the instability of operation of the arc-type ion source of the accelerating tube, i.e., by fluctuations in the current of accelerated D ions. The curves for the probability density of the neutron yield per pulse serve as the most complete characteristic of the yield parameters of neutron-pulse generators using vacuum tubes; i.e., they determine the mean yield, the most probable yield per pulse, and the scatter of the neutron yields per pulse. (4 figures, 2 tables) (R.W.R.)

51240 (BNL–16850) REMOTE TARGETING SYSTEM FOR ACCELERATOR PRODUCTION OF ISOTOPES. Horn, Fred L. (Brookhaven National Lab., Upton, N. Y.). May 1972 14p. (CONF-720903–13). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

A positioning mechanism for the manipulation of multiple targets in the beam line of the Brookhaven 200-MeV proton linac is described. The targets with integral forced-water cooling are placed in a helium atmosphere under a 10 meter water shield. (auth)

51241 (CONF-710964–, pp 290-2) THREE-DIMENSIONAL FIELD COMPUTATIONS FOR C MAGNETS AND ELECTROSTATIC SEPARATORS. Christian, R.; Vogel, H. (Purdue Univ., Lafayette, Ind.). 1971.

In Proceedings of the third Reno conference on magnetic fields. Computer calculations for the fields of a C magnet for the stopped muon channel at LAMPF and for electrostatic beam separators are briefly described. (W.H.K.)

51242 (JAERI-Memo–4023) APPARATUS FOR SCATTERING CROSS SECTION MEASUREMENT. Ohtomo, S.; Okamoto, K.; Ohno, Y. (Japan Atomic Energy Research Inst., Tokyo). May 1970. (In Japanese). NTIS (U. S. Sales Only).

An apparatus for scattering cross-section measurements is reported, which consists of a scattering chamber, ten BF_3 proportional counters annularly arranged and a sample changer in the center of the chamber. Transmission measurements can also be made by using an additional BF_3 counter. The apparatus is set on a goniometer-arm of the JAERI crystal monochromator. The results of scattering cross-section measurements with this apparatus are also given. (auth) (Japan)

51243 (LA–4862) FABRICATION TECHNIQUES FOR LIQUID H_2 ACCELERATOR TARGETS. Eaton, E. E.; Ehart, E. P.; Kelly, D. J. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 6p. Dep. NTIS.

Techniques are presented for fabricating a cylindrical liquid H_2 accelerator target from 0.005-in. Kapton film. Two unique modifications of existing target construction technology were developed: (1) hydroforming of target end domes, and (2) the use of a water-soluble mandrel to facilitate adhesive bonding of the second end dome to each target cylinder. The targets are for use in the Los Alamos Meson Physics Facility. They are pressure-tested at 30 psig with liquid N_2 before use. (auth)

51244 (LA–4982) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending April 30, 1972. Dunn, Eleanor (comp.) (Los Alamos Scientific Lab., N. Mex.). Jul 1972. Contract W-7405-eng-36. 50p. Dep. NTIS.

Progress in engineering support, accelerator systems development, electronic instrumentation and computer systems, accelerator operations, the experimental area, and physics research is summarized. Practical applications of LAMPF are discussed, and work of the LAMPF Users Group is reported. Also, publications are listed. (W.H.K.)

51245 (LAL–1263) LIQUID DEUTERIUM TARGETS. Blum, D.; Boucrot, J.; McGill, W.; Nguyen Ngoc, H.; Grossetete, B.; Henault, J. P.; Motta, R.; Roch, M.; Round, V. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). May 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only).

An original liquid deuterium target was built at the Orsay Linear Accelerator Laboratory to study the interaction of a 400 MeV chromatic gamma ray with deuterons. A description of the target and the automatic system which provides this target with liquid deuterium for a period of several weeks without any human intervention is given. (France)

51246 (RHEL/R–240) K9 COMPUTER SOFTWARE SYSTEM. Adams, P. (Rutherford High Energy Lab., Chilton (England)). Dec 1971. 71p. Dep. NTIS (U. S. Sales Only). UK 80 pence.

The computer control system for the NIMROD K9 beam line for injection into a hydrogen bubble chamber is described. The RTI-70 language is described, and operation of the system is detailed. (W.H.K.)

51247 (SC-RR–720404) INTERACTION OF A PULSED RELATIVISTIC ELECTRON BEAM WITH A SINGLE-ENDED MAGNETIC BOTTLE. Bolduc, P. E.; Patterson, E. L. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 61p. Dep. NTIS.

A magnetic mirror was used to control and focus a 2.0-MeV, 70-kA electron beam. Mirror ratios of 2.5, 3.7, and 5.9 and magnetic fields of 2.0, 2.5, and 5.0 kG were used. A 500 μ air pressure was used in the drift tube to minimize electrostatic and magnetic self-forces of the beam. The surface energy deposition in a sample placed at the peak of the 3.7-to-1 bottle was approximately twice as large as that obtained with beam self-focusing without an external field. The fluence and energy as a function of axial position in the region of low grade B_z agreed with results of adiabatic theory, and were found to be independent of magnetic field strength and nearly independent of mirror ratio for the selected ranges. Reproducibility in delivered energy, fluence, and surface energy deposition was significantly greater than that obtained without an external magnetic field. The induced B_z field due to beam rotation or plasma diamagnetism was approximately 1 percent of the applied field. The use of oil prepulse switches allowed the REBA diode to be operated at an impedance of less than 10 ohms as contrasted to the normal 70-ohm operation. This is beneficial for increasing the specific surface dose delivered to a sample. (25 figures, 2 tables) (auth)

51248 DT NEUTRON PRODUCTION RATES BY ACTIVATION ANALYSIS. Lawson, R. C.; Porter, D.; Hannan, W. J.

(Western Regional Hospital Board, Glasgow). Radiochem. Radioanal. Lett.; 10: No. 6, 323-9(15 Jul 1972).

An accurate method of measuring the total neutron production rate of a sealed-tube DT generator is presented. The influence of scattered neutrons in the irradiation system is considered. (1 figure, 2 tables) (auth)

51249 SOME OBSERVATIONS ON VARIABILITY IN THE X-RAY BEAM FROM A 5 MV LINEAR ACCELERATOR WITH A BENDING MAGNET TO DEFLECT THE ELECTRON BEAM THROUGH 90^0. Walker, D. H. (Queensland Radium Inst., Brisbane). Australas. Bull. Med. Phys. Biophys.; No. 54, 10-17(1 Jun 1972).

In treatment planning and clinical use of an x-ray unit, it is basically assumed that the distribution of dose about the beam axis is independent of the orientation of the beam axis in space. In a number of linear accelerators now in use, the electron beam, after acceleration, is deflected through 90° before striking the target, thus introducing an inherent asymmetry into the beam. Some observed variations in flatness, symmetry, dose-rate and target spot position, and in the relation between monitor dose and peak axis dose (with and without a wedge filter) from an A.E.I. Series III 5 MV Linear Accelerator, are presented. The selection of a simple criterion for satisfactory operation under most clinical conditions is discussed. (auth) (Australia)

51250 PROTON REACTIONS WITH COPPER FOR AUXILIARY CYCLOTRON BEAM MONITORING. Greene, M. W.; Lebowitz, E. (Brookhaven National Lab., Upton, N. Y.). Int. J. Appl. Radiat. Isotop.; 23: No. 7, 342-4(Jul 1972).

It is suggested that foil techniques in addition to beam-current integration can be used for monitoring cyclotron beams to determine the amount of beam actually striking the target. To assess the precision of the method, measurements of proton cross sections on copper were made. Cross sections for the reactions ^{63}Cu(p,2n)^{62}Zn and ^{65}Cu(p,n)^{65}Zn are compared with results from previous work. (UK)

51251 MEASUREMENT OF γ-DETECTOR CHARACTERISTICS. Govorkov, B. B.; Denisov, S. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 224-32(1971). (In Russian).

A method of monochromatization of γ quanta is described for the determination of the effectiveness, energy resolution, and other characteristics of photon detectors. A 264-MeV electron synchrotron target produces a bremsstrahlung beam which produces electron–positron beams; a monoenergetic electron beam is separated from this beam and is used to produce a monoenergetic photon beam. (W.H.K.)

51252 DEVICE FOR DISSIPATING LARGE THERMAL FLUXES UNDER HIGH VACUUM IN THE PRESENCE OF A MAGNETIC FIELD. Descleve, Pierre; Martin, Jean (to Groupement Atomique Alsacienne Atlantique). French Patent 2,086,724. 6 Dec 1971. Filed 7 Apr 1970. (In French).

A device is presented which enables the efficient cooling under high vacuum of parts subjected to large thermal fluxes in the presence of high magnetic fields (flux resulting from intense neutron bombardment, or irradiation with x rays, or neutral or electrically charged particles). Conditions such as these apply to accelerator targets. The device consists of, essentially, a sealed helicoidal-shaped circuit possessing at least one turn. This circuit is in thermal contact with the parts requiring cooling. An electrically conducting coolant fluid flows through this circuit. Each turn is provided with a flattened portion, formed between two mutually parallel planes, positioned perpendicularly to the magnetic field, the two other faces being connected to electrodes between which a current is passed. This current is perpendicular to the magnetic field. The resultant electromagnetic force guides the coolant around the helicoidal circuit. (France)

51253 LIQUID NITROGEN-COOLED ROTATING TARGET FOR RADIATION ANALYSIS. Habanec, Josef; Sebek, Zdenek; Palivec, Stanislav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 18: No. 8, 276-8(Aug 1972). (In Czech).

A rotating target has been designed and tested which permits analysis of thermally unstable materials or liquids by means of elastic scattering of particles. The construction of the rotating target is described, and sample spectra of particles scattered by carbon, oxygen (water), and fumaric acid are presented. Much of the work was performed with 3 MeV protons from a Van de Graaff generator. (tr-auth)

51254 PHYSICAL-TECHNOLOGICAL PRINCIPLES OF THE RADIATION THERAPY WITH HIGH-ENERGY PROTONS. Vainberg, M. S.; Savchenko, O. V.; Choroskov, V. S. (Inst. for Experimental and Clinical Oncology, Moscow). Radiobiol.-Radiother.; 13: No. 3, 293-305(1972). (In German).

The physical and physical-technological problems of the production of medical proton beams for the radiation therapy of oncological patients by proton accelerators of the USSR are considered. The principal characteristics of medical proton beams of the Laboratory of Nuclear Problems in the United Nuclear Research Institute (Dubna) are given, and the technological problems of the irradiation of patients with protons are discussed. (10 figures, 1 table) (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

51255 (NEIC-RR-45) NUCLEAR AND RELATIVISTIC ASTROPHYSICS AND NUCLIDIC COSMOCHEMISTRY: 1963–1967. VOLUME IV. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1971. 209p. Dep. NTIS (U. S. Sales Only).

An author index for the literature survey NEIC-RR-34 (NSA 25816) and bibliography NEIC-RR-37 and NEIC-RR-38 (NSA 25817 and 25818) is presented. (W.D.M.)

Cosmic Radiation

Refer also to abstracts 51438 and 51574.

51256 (COO-3130-TA-258) NOTE ON SINGLE-PARTICLE SPECTRA AT COSMIC RAY ENERGIES. Shen, Ming-liang (Brown Univ., Providence, R. I. Dept. of Physics). 1971. 10p. Dep. NTIS.

It is shown that the primary energies of cosmic ray events analyzed recently at BNL and Vanderbilt University should be, on the average, of the order of only several 10^3 GeV, instead of being greater than 10^4 GeV. The effect on the conclusion of their work is discussed. This claim is further supported by the various agreements of their experimental results with the theoretical predictions under the alternate choice of lower primary energies. Finally, the problem of normalization is discussed. (auth)

51257 XENON IN TERRESTRIAL AND EXTRATERRESTRIAL MATTER (XENOLOGY). Hintenberger, H. (Max-Planck-Institut fuer Chemie, Mainz). Naturwissenschaften; 59: No. 7, 285-91 (Jul 1972). (In German).

Detailed studies of the isotopic abundances of the element xenon are of increasing importance about our knowledge of the formation of the heavy elements and the early history of the solar system. The new discipline that emerged from these studies is called "xenology." Sections are devoted here to: variations in abundances of xenon isotopes and their causes; nuclear reactions in formation of xenon isotopes; xenon of the Earth, the Sun and stars; xenon in meteorites; and xenon on the Moon. (38 references) (TSS)

51258 ENERGY SPECTRUM AND COMPOSITION OF PULSAR-ACCELERATED COSMIC RAYS. Sitte, K. (Univ., Freiburg i. B. Laboratorio di Cosmo-Geofisica, Turin); Briatore, L.; Dardo, M. Nuovo Cim.; 10B: No. 2, 498-510(11 Aug 1972).

In traversing the expanding shell of the supernova, pulsar-accelerated heavy nuclei will suffer collisions with the shell gas which lead to attenuation, and to fragmentation. Since the attainable energy decreases in time as the pulsar slows down, and the shell thins out, cosmic-ray particles of the highest energy will be most strongly affected. Using the example of the Gunn–Ostriker model it is shown that (1) the attenuation reduces the maximum energy of the particles that penetrate the shell to about 0.03 of the highest energy the pulsar can produce, (2) the attenuation is stronger for heavy nuclei than for protons so that these particles remain dominant, and (3) a substantial fraction ($\sim 2.7 \times 10^{-4}$ in relation to protons) of L nuclei in the cosmic radiation is formed. In addition, it is shown also that the revised model provides abundant production of L nuclei in the shell gas, and that the absorbed particle radiation accelerates the shell to a modest degree only. (auth)

51259 OBSERVATIONS AT 6 MHz OF RADIO PULSES FROM EXTENSIVE AIR SHOWERS. Felgate, D. G.; Stubbs, T. J. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 90-1 (Mar 1972).

Observations were made from June to November 1971, and 102 events were recorded via their associated radio pulses. (Australia)

51260 ASPECTS OF HIGH ENERGY ASTROPHYSICS. Prescott, J. R. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 70-1(Mar 1972).

Cosmic rays of energies upwards of 10^{15} eV are discussed in terms of interpretations of pulsar environments and other possible specific sources. Theories of galactic and extragalactic cosmic-ray origin are briefly compared. (Australia)

51261 SELECTED PAPERS ON COSMIC-RAY-ORIGIN THEORIES. Rosen, Stephen (ed.). New York; Dover Publications, Inc. (1969). 446p.

This collection of papers was conceived during some research on the origin of cosmic rays. It was felt that some papers were of more fundamental importance than others. A source book containing a selection from the most outstanding material seemed appropriate to supplement the reviews and texts and to afford a convenient introduction to the subject. (W.D.M.)

51262 CHANGE IN THE AGE PARAMETERS OF EXTENSIVE AIR SHOWERS AS A FUNCTION OF THEIR PENETRATION COMPONENT. Catz, Philippe; Hochart, Jean-Pierre; Maze, Roland; Zawadzki, Alexandre (CNRS, Verrieres-le-Buisson, France). Compt. Rend., Ser. B; 274: No. 14, 907-10(5 Apr 1972). (In French).

It was experimentally shown that the value of the age parameter, s, increases with the density of the penetration component of a constant-size shower. This effect is attributed to the change in the generation height. (France)

51263 SOME PROBLEMS OF γ-RAY POINT SOURCE SEARCH BY REGISTRATION OF CHERENKOV LIGHT FROM EXTENSIVE AIR SHOWERS. Stepanyan, A. A.; Pavlov, I. V. Izv. Krym. Astrofiz. Observ.; 43: 37-41(1971). (In Russian).

Different methods of high-energy gamma-ray source search by registration of Cherenkov light from extensive air showers are considered. The calculation results of the efficiency of different search methods are presented. A preliminary experimental estimation of the influence of atmospheric transparency upon Cherenkov flash registration was made. (auth)

51264 PRELIMINARY RESULTS OF PULSAR CP 1133 OBSERVATIONS USING CHERENKOV LIGHT REGISTRATION FROM EXTENSIVE AIR SHOWERS. Stepanyan, A. A.; Vladimirskii, B. M.; Pavlov, I. V.; Fomin, V. P. Izv. Krym. Astrofiz. Observ.; 43: 42-8(1971). (In Russian).

An installation for the observation of Cherenkov flashes from extensive air showers is described. A choice of essential parameters of the apparatus is discussed. The best fast photomultipliers with the multi-alkali cathode of high quantum efficiency are used. In order to find an optimum field-of-view the measurements of the angle size of Cherenkov flash were made. The angle size of the flash is 2.4 ± 0.2° for the energy of the showers about 10^{13} eV. The dependence of a receiving cone upon the minimum energy of the showers registered was investigated. Taking into account this dependence, the size of the flash, and some other considerations, the field of view must be $(1.4 \text{ to } 1.0) \times 10^{-3}$ sterad. Regular observations began in March–April 1969. Pulsar CP 1133 has revealed some flux excess equal to 2.3 standard deviation. (auth)

51265 γ RADIATION FROM THE EARTH AND NEUTRINO EXPERIMENTS. Glotov, V. I. This paper was summarized in At. Energ. (USSR); 30: No. 4, 384-5(Apr 1971) as paper No. 479/5862. (In Russian).

Full copy of this paper is held by TIC.

The most important sources of natural terrestrial γ radiation constituting a basic component of the external background in electronic neutrino detectors, and in particular in the lithium-drifted electronic detector, are discussed. The discussion centers around the example of granite of average chemical composition containing 3.5×10^{-6} g/g uranium, 1.8×10^{-5} g/g of thorium, and 3.3×10^{-2} g/g potassium. Yields of γ photons generated through decay of uranium, thorium, and potassium, and in spontaneous fission of ^{238}U in $(\alpha\gamma)$, $(\alpha,\alpha'\gamma)$, $(\alpha,n\gamma)$, $(\alpha,p\gamma)$, $(n\gamma)$, $(n,n'\gamma)$ reactions are estimated. (W.D.M.)

51266 INVESTIGATION OF COSMIC RADIATION AT SEA LEVEL. Mehnert, W. (Univ., Rostock, Ger.). Exp. Tech. Phys.; 20: No. 1, 31-6(1972). (In German).

An attempt was made to compute an expression for the relation of counting rate and counter-area at parallel-plate-counters with large areas, which are exposed to sea-level cosmic rays under consideration of the contemporary tracks. Comparison of the counting plots obtained with this expression and the measured counting plots shows that the observed effect of the slower rise of the counting rate with increasing counter area might be explained with the presence of multiple tracks in cosmic rays. (auth)

51267 FUTURE OF BALLOONS IN COSMIC-RAY RESEARCH. Peters, B. (Danish Space Research Inst., Lyngby). Space Sci. Rev.; 13: No. 2, 313-18(Jun 1972).

In spite of the availability of satellites, the possibility of increasing basic knowledge of cosmic radiation with the help of balloons has not diminished. New detection techniques have made it possible to enter new areas of study which had been closed earlier. (auth)

Stars

Refer also to abstracts 51574, 51665, and 51918.

51268 (AD-735673) INFRARED STARS: CHARACTERISTICS OF OH EMISSION. Report for August 1969–August 1971.

Wilson, William J.; Barrett, Alan H. (Aerospace Corp., El Segundo, Calif.). 30 Nov 1971. Contract F04701-71-C-0172. 72p. (SAMSO-TR-71-323). NTIS.

The characteristics of OH emission sources associated with late M-type variable stars are discussed. A total of 456 IR stars and 18 other objects were surveyed and OH emission was detected from 25 IR stars. Including four OH sources discovered by other observers, there are 29 OH emission sources associated with IR stars. In addition there are 8 OH sources that have OH emission characteristics similar to the OH/IR stars but for which no IR star has yet been detected. Based on their OH, IR, and visual properties, the OH/IR stars can be divided into three groups. The group of OH/IR stars (19 stars) with their OH emission strongest at 1612 MHz and concentrated in two narrow velocity ranges is discussed. (auth) (NTIS)

51269 INTERSTELLAR REDDENING WITHIN 200 pc OF THE SUN. Stromgren, B. (Univ. of Copenhagen). Quart. J. Roy. Astron. Soc.; 13: No. 2, 153-60(Jun 1972).

It is stated that analysis of observations giving interstellar reddening as well as distance for individual stars within a few hundred parsecs may contribute to the solution of the problems of the spatial distribution of the interstellar particle medium. The information gained is relevant in the discussion of the general problem of the cloud–intercloud structure of interstellar matter. Previous work (Strömgren, 1962) utilized UBV and Hβ photometry of B8 and B9 stars by Crawford (Astrophys. J. 137, 530, 1963) for an analysis of interstellar reddening within 200 pc of the Sun. A continuation of the earlier work utilizes an observational material consisting of uvby and Hβ photometry for 572 A0 stars brighter than V = 6.5m and north of declination −20° (Crawford et al. (Astr. Astrophys. Suppl. 5, 109, 1972)). (UK)

51270 K-LINE LUMINOSITIES AND THE CALIBRATION OF MK CLASSES FOR G AND K GIANTS. Pagel, B. E. J. (Royal Greenwich Observatory, Herstmonceux, Eng.). Quart. J. Roy. Astron. Soc.; 13: No. 2, 164-76(Jun 1972).

Recent MK calibrations in the range G7 III to K5 III imply that K-line luminosities by O. C. Wilson for field red giants are, on the average, about 0.5m too faint. The validity of this result, which is compatible with the effect of metal abundance suggested by previous work, is confirmed by a study of the trigonometric parallaxes of an almost complete sample of G–K giants brighter than V = 3.80m and north of declination −20°. (auth)

51271 RED VARIABLES IN GLOBULAR CLUSTERS, IN THE GALACTIC CENTRE AND IN THE SOLAR NEIGHBOURHOOD. Feast, M. W. (Radcliffe Observatory, Pretoria). Quart. J. Roy. Astron. Soc.; 13: No. 2, 191-201(Jun 1972).

Mira variables are present in at least five globular clusters; the periods where known are near 200 days. All the clusters concerned are relatively metal rich. Some red variables in the halo globular cluster ω Cen have strong TiO bands in their spectra. This must affect the positions of these stars in the color–magnitude diagram. Possibly some of the halo M giants discussed by Eggen are field counterparts of these ω Cen stars. It was suggested that the red variables near the galactic center are abnormal (possibly due to an abnormal chemical composition). However, spectra of some of the Baade–Gaposchkin Mira variables in the galactic center field around NGC 6522 show that they have normal spectral types (and emission lines) for their periods. TiO bands are weak or absent in the spectra of red giants in the globular cluster NGC 6522 itself, whereas they are conspicuous in the red giants in 47 Tucanae. The distance to NGC 6522 and the reddening for the galactic center field derived by fitting NGC 6522 to a 47 Tuc-type color–magnitude diagram must therefore remain in doubt. Analysis of the radial velocities of semi-regular variables in the solar neighborhood (including many new determinations from Pretoria and Herstmonceux–Kottamia work) indicates that they constitute an old disk population. Neither these stars nor the Me variables show a net inward motion in the Galaxy relative to young objects as might be expected on the basis of Kerr's expansion model for the 21-cm observations. (auth)

51272 PRELIMINARY INVESTIGATION OF THE DEPENDENCE OF M_v(K) ON [Fe/H]. Wilson, O. C. (Carnegie Institution of Washington, D. C.); Olsen, E. H.; Kjaergaard, P. Quart. J. Roy. Astron. Soc.; 13: No. 2, 161-3(Jun 1972).

It is known that the widths of the chromospheric emission components of the H and K lines of Ca II increase with the absolute magnitudes of the stars in which they are observable (spectral types G, K, and M). Observations were made to determine whether the line widths are not only a function of M_v, but depend also on metallic abundance. It was necessary, for a reasonably large group of stars, to make good determinations of abundance together with accurate absolute magnitudes measured independently of the K-line procedure. Observations of a number of physical binaries in which the primaries are late-type giants and the secondaries are earlier-type (A–F) main-sequence stars are reported. The results do not suggest any strong dependence of M_v(K) upon [Fe/H] for the abundance range covered by the observations. (UK)

51273 SURVEY FOR RR LYRAE STARS AT HIGH GALACTIC LATITUDE. Kinman, T. D. (Kitt Peak National Observatory, Tucson, Ariz.). Quart. J. Roy. Astron. Soc.; 13: No. 2, 258-65 (Jun 1972).

It is stated that to investigate the structure of the Galaxy a class of astronomical objects must be selected which has some significant property. Possible classes of object are considered, and reasons are given for selecting RR Lyrae, which are the most abundant of variable stars and have distinctive periods and light curves. They are intrinsically quite bright and can be readily recognized at considerable distances. Like the globular cluster population to which they belong, they show properties which correlate with chemical composition. In general it is considered that they are the best available tracers of the galactic halo. Progress in the survey of RR Lyrae stars, and the need for improved knowledge of the intrinsic properties of these stars and of how they relate to other globular cluster stars, are discussed. (UK)

51274 NOTE ON STELLAR WINDS AND BREEZES. Freeman, N. C.; Johnson, R. S. (Univ. of Newcastle upon-Tyne, Eng.). Proc. Roy. Soc. (London), Ser. A; 329: No. 1577, 241-9(8 Aug 1972).

The radial flow of an inviscid heat-conducting gas, with gravitational effects, is considered. The gas is assumed nonmonatomic, but the limit to the monatomic state is considered in great detail. It is shown that the results of Roberts & Soward (Proc. Roy. Soc. Lond. A. 328. 185(1972)) can be predicted from the present analysis, and further that considerable light is shed on their results. For the nonmonatomic gas, the various asymptotic regions (obtained when the energy flux at infinity approaches zero) are far simpler in their details than those encountered by Roberts & Soward. (auth)

51275 MEASURING STELLAR OPTICAL ENERGY. Garforth, P. J. (Hewlett-Packard Co., Palo Alto, Calif.). Opt. Laser Technol.; 4: No. 4, 173-4(Aug 1972).

The conventional method of spectral analysis of light energy is based on an optical technique using prisms, gratings, etc. Forrester (J. Opt. Soc. America, 51: 253(1961)) postulated that spectral analysis of a light source could be achieved by mixing a specially chosen light beam with the source signal to translate the information down to radio frequencies. The advantages of optical heterodyne detection are that a better analysis resolution can be obtained, and a significant part of the instrumentation can be mechanised using conventional electronic circuitry, thus allowing a greater flexibility in planning and running an experiment. Experiments were conducted by Nieuwenhuijzen (Bull. Astr. Inst. of the Netherlands, 19: 391(1968)) to test the usefulness of this method of analyzing the light-energy distribution from bright stars. A Hewlett–Packard 3721A correlator was used as part of the electronic apparatus. The experiments are described. (auth)

51276 REDETERMINATION OF THE ZERO AGE MAIN SEQUENCE. Evans, T. L. (Radcliffe Observatory, Pretoria). Quart. J. Roy. Astron. Soc.; 13: No. 2, 177-82(Jun 1972).

The zero-age main sequence (ZAMS) was first defined by Sandage (Astrophys. J., 125: 435(1957)). The currently used versions differ little from that of Sandage. The basic assumption that a unique ZAMS exists has not been seriously challenged, but the observed main sequence may differ from that and between one cluster and another. This is a result of the differences both in chemical composition and, especially, in distribution of rotational velocities along the main sequence that were recently shown to exist between different clusters. Since these quantities are not likely to be determined in the near future for all the many clusters whose distances are required, there is still a need for a ZAMS that will give correct distances on average. The construction of the ZAMS was therefore investigated using new material. The work is described in sections: establishing the zero point (using the moving cluster parallax of the Hyades), main-sequence fitting (fitting the Pleiades to the Hyades–Praesepe main sequence, fitting the α Persei cluster, fitting NGC 2362), additional young clusters (IC 2581, h and χ Persei), the Scorpio–Centaurus Association (important in providing a direct check on the location of the upper main sequence by an independent moving cluster parallax), hydrogen line distances. (UK)

51277 ROTATION OF STELLAR MODELS IN NEWTON'S THEORY. Skhtoryan, E. M.; Chubaryan, E. V.; Papoyan, V. V. Dokl. Akad. Nauk Arm. SSR; 53: No. 2, 84-8(1971). (In Russian).

An equation is presented which relates to the structure and integral parameters of pseudo-spheroidal stellar models rotating at constant angular velocity. A method for calculating the structure and integral parameters of rotating configurations is developed within the framework of Newton's gravitational theory. (K.S.W.)

51278 SPECTRAL CLASSIFICATION OF CANIS MAJORIS β STARS AND THEIR POSITION IN THE HR DIAGRAM. Rountree-Lesh, Janet; Aizenman, Morris (Joint Inst. for Lab. Astrophysics, Boulder, Colo.) Compt. Rend., Ser. B; 274: No. 14, 911-14(5 Apr 1972). (In French).

Spectroscopic and photometric studies were used to locate the variable β-type Canis Majoris stars in the HR diagram with respect to normal B stars. Using evolution models, a hypothesis was made concerning their stage of evolution (following the central combustion of hydrogen stage). (France)

51279 EVOLUTION OF THE NUCLEI OF PLANETARY NEBULAE. Faulkner, D. J. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 2, 72-6(Mar 1972).

Some observational properties of planetary nebulae are summarized. These include galactic occurrence, shell mass, expansion velocity, shell abundances, stellar temperature, distances and luminosities, and the Harman–Seaton track and time scale. Calculations relevant to the evolution of planetary nuclei were made in the areas of helium core-burning, evolution of low-mass stars, their helium shell burning, and shell ejection by radiation pressure. The mechanism for shell ejection depends upon the luminosity of the projector star reaching a sufficiently high value. This may occur by a slow rise up the giant branch associated with quiescent aspects of the double shell-source evolution, or very rapid rises associated with thermal pulses. (Australia)

51280 DEVELOPMENT OF A BLACK HOLE: THE OPPENHEIMER-SNYDER DUST CLOUD. Szekeres, P. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 110-11(Mar 1972).

A coordinate system valid throughout the history of the cloud is proposed, which provides a match of the interior and exterior coordinates and is valid beyond the critical radius. (Australia)

51281 VARIABLE POLARIZATION OF T CEN. Peterson, A. Victoria (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 2, 108-10(Mar 1972).

The polarization in the uv and visual show qualitatively the same time dependence, but polarization is greater in the uv and less in the visual than in the blue. For interstellar polarization, the wavelength dependence is flat in the blue and visual and drops slightly in the uv. There is only a small interstellar polarization component. (Australia)

51282 CD -42^0 14462: A ROTATING WHITE DWARF. Wegner, G. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 2, 107-8(Mar 1972).

Present observations indicate that CD – 42° 14462 has a composite spectrum. It does not seem to be a binary for this would require a very improbable system; in addition, the light variations don't have a short-enough period. The estimated value of $v \sin i = 2000$ km/sec is below the breakup value for white dwarfs. (auth)

51283 THERMAL PULSES IN HELIUM SHELL-BURNING STARS. Faulkner, D. J.; Wood, P. R. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 2, 105-6 (Mar 1972).

An investigation of the thermal instability in a 0.8 $M_\odot$ helium shell-burning star with a detailed shell abundance profile indicated a single thermal pulse at the end of the shell-burning evolution. Without neutrino losses the shell-source becomes extinct at a mass fraction of 0.98 as carbon burning commences in the core. With the losses included, the temperature at all points in the star remains below $\log T = 8.55$ and carbon-burning is suppressed. The helium shell thus remains active and the thermal instability disappears at mass fraction 0.991. (Australia)

51284 NEUTRON STARS. Chiu, H. Y. (Goddard Space Flight Center, New York). pp 111-18 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

The qualitative features of a fermi gas are considered and several important properties of neutron matter are discussed including the superfluid state, crystallization of matter at subnuclear densities, rotation, and magnetic fields. (W.D.M.)

51285 PROBLEMY ASTRONOMII I GEODEZII. (Problems in Astronomy and Geodesy). Fourth Congress of the All-Union Astronomical-Geodetic Society, Riga, USSR, October 1965. Martynov, D. Ya. (ed.). Moscow; Izdatel'stvo Nauka (1970). 240p. (CONF-651012).

This collection of 41 papers are classified under the headings astronomy, geodesy, training methods for astronomers, and popularization of astronomy. Of chief interest here are a few papers on, respectively, the Ikeya–Seki comet, noctilucent clouds, galactic structure and magnetic fields, star compression, the aberration of light, and the theory of relativity. Problems of geodetic measurements and instruments are presented in 15 papers, and the last 15 papers are related to pedagogical techniques in handling astronomical knowledge. (K.S.W.)

51286 COLLISIONAL EXCITATION AND IONIZATION RATES OF THE HYDROGEN ATOMS. Gershberg, R. E.; Korovyakovskaya, A. A.; Korovyakovskii, Yu. P. Izv. Krym. Astrofiz. Observ.; 43: 49-51(1971). (In Russian).

The collisional excitation and ionization rates of hydrogen atoms, calculated in accordance with classical theory and by the quantum-mechanical formulae, are compared. The ratios of the corresponding values do not exceed 1.5 to 2.5. Taking into account the preference of analytical formulae and the scant experimental data on the excitation and ionization of high levels it is reasonable to use the classical formulae in most cases of astrophysical calculations. (auth)

51287 REFLECTION EFFECT IN THE ERUPTION STARS. Grinin, V. P. Izv. Krym. Astrofiz. Observ.; 43: 52-65(1971). (In Russian).

The problem of the non-stationary radiation of semi-infinite homogeneous medium illuminated by a point source, whose power depends on time, has been solved. It is assumed that the scattering medium is a plane-parallel gas layer in LTE state and its optical properties do not change with time. The values which permit to calculate the energy reflected by the medium at any luminosity change law of the source have been obtained. As an example, the case when the luminosity change L(u) corresponds to the irreversible recombination of an optically thin layer of a hydrogen gas at a constant temperature is considered. The energy change curves of total radiation E^Σ (the direct radiation of a flare and the radiation reflected by the atmosphere) were computed assuming that the point source is both outside and inside the atmosphere at an optical thickness of an order of one. In the case of the source being inside the atmosphere a second maximum can take place on the curve of E^Σ change due to diffuse radiation. The color change of total radiation is considered also. (auth)

51288 UV CET TYPE STAR ROTATION. Gershberg, R. E. Izv. Krym. Astrofiz. Observ.; 43: 66-70(1971). (In Russian).

The upper limits of flare-star rotational velocities were evaluated by two methods—from photometric features of stars and on the basis of the widths of the Hα emission line in the quiet chromosphere. The rotational velocity of UV Cet does not exceed 22 km/sec, YZ CMi 37 km/sec, the v sin i of EV Lac does not exceed 25 km/sec, and AD Leo 52 km/sec. (auth)

51289 IMPROVEMENT OF THE SPECTROSCOPIC ORBIT OF Y Cyg. Vitrichenko, E. A. Izv. Krym. Astrofiz. Observ.; 43: 71-5(1971). (In Russian).

Data were obtained from 26 new radial velocity measurements. This data and that of other authors were used for the improvement of the spectroscopic orbit by least square. Masses and radii of components were found to be: $M_1 = 16.4_\odot$; $M_2 = 17.0_\odot$; $R_1 = R_2 = 5.97_\odot$. The change of γ velocity is discussed in brief. Its variability is not confirmed. (auth)

51290 DOUBLE STAR HD 175514. III. ON ANALYSIS OF OBSERVATIONS IN 1968. Vitrichenko, E. A. Izv. Krym. Astrofiz. Observ.; 43: 76-86(1971). (In Russian).

The photoelectric light curve obtained in 1968 was rectified and solved by least squares for a model of a similar ellipsoid and uniform disk. New radial velocity measurements were obtained. The spectroscopic orbit was improved. The mass ratio was determined by the spectrophotometric method. Absolute characteristics are: $m_1 = 28_\odot$; $m_2 = 10.7_\odot$; $r_1 = 9.6_\odot$; $r_2 = 3.5_\odot$. Some peculiarities of the system: the synchronism of rotation and revolution, the position of components with respect to the Roche critical surface, anomalies of the light curve, and the validity of the model were discussed. (auth)

51291 SPECTROPHOTOMETRIC STUDY OF THE ECLIPSING-VARIABLE SYSTEM COMPONENTS. I. Rachkovskaya, T. M. Izv. Krym. Astrofiz. Observ.; 43: 87-100(1971). (In Russian).

Spectrograms of the eclipsing systems AH Cep, CW Cep, σ Aql, AG Per, U Oph, and AR Aur were obtained with a dispersion of 15 and 36 Å/mm in the phases 0.00p, 0.25p, 0.50p, and 0.75p. From these spectrograms the mean spectral types, the rotational velocities v sin i, and absolute visual magnitudes M_V were determined for every component of the system. The results of the study showed that these systems lie on the main sequence or close to the zero-age line. Most of the systems studied are supposed to have the axial–orbital synchronism. (auth)

51292 SPECTROPHOTOMETRIC INVESTIGATION OF THE Ap TYPE STARS. I. A TWO DIMENSIONAL QUANTITATIVE SPECTRAL CLASSIFICATION. Leushin, V. V. Izv. Krym. Astrofiz. Observ.; 43: 113-29(1971). (In Russian).

56 Ap-type stars and 28 normal stars were analyzed on the basis of spectrograms with a dispersion of 14 Å/mm. Spectral classes and luminosities obtained from the spectral lines of helium (Sp (He)), iron (Sp(Fe)) and hydrogen (M_v) are discussed. (W.D.M.)

51293 EVOLUTION OF GLOBULAR CLUSTERS. Ostriker, Jeremiah P.; Spitzer, Lyman Jr.; Chevalier, Roger A. (Princeton Univ. Observatory, N. J.). Astrophys. J.; 176: No. 2, L51-6 (1 Sep 1972).

The evolution of globular clusters is dominated by dynamical relaxation, produced by two-body encounters, and by gravitational shocks, which occur whenever a cluster passes through the galactic plane; the variation with Z of the gravitational acceleration, g(Z), produces a change in acceleration across the cluster which increases the random kinetic energy of the cluster stars. Observational data are used to evaluate these two effects; at present dynamical relaxation is much more important for the observed stars in most clusters. For the less massive stars, which presumably are farther from the center of each cluster, the effect of gravitational shocks is considerably increased. These two effects together have tended to cause the escape from the observed clusters of most of the less massive stars, possibly accounting for the low mass–luminosity ratio observed in clusters. The Population II stars in the disk may consist, in significant part, of stars formerly in globular clusters; some clusters may have dissipated entirely. Since the relaxation times for about half of the clusters appear to be shorter than 10^9 years, collapse of the central cores of these systems appears unavoidable within less than 10^{10} years from now, leading probably to massive supernovae. (auth)

51294 VARIATION OF THE NITROGEN ABUNDANCE AMONG POPULATION II OBJECTS. Hartwick, F. D. A. (Univ. of Victoria, B. C.); McClure, R. D. Astrophys. J.; 176: No. 2, L57-9(1 Sep 1972).

Intermediate-band photometry, on the DDO system, of individual giant stars in the anomalous globular cluster NGC 7006 confirm the weak-metal-lined character exhibited by integrated light observations but indicate anomalously strong cyanogen bands. These results are consistent with the possibility that the nitrogen abundance is the elusive second parameter affecting the color–magnitude diagrams of globular clusters. (auth)

51295 STELLAR-STATISTICAL PROBLEMS. Eelsalu, H. Tartu; Tartuskaya Astrofizicheskaya Observatoriya (1971). 22p.

Separate abstracts were prepared for the two chapters included. (W.D.M.)

For abstracts of individual chapters see: 51296 and 51297.

51296 STELLAR-STATISTICAL PROBLEMS. I. ON RELATIONS BETWEEN, AND SYSTEM-THEORETICAL DESCRIPTION OF, ASTRONOMICAL DISCIPLINES. Eelsalu, H. pp 3-14 of Stellar-Statistical problems. /Eelsalu, H. Tartu; Tartuskaya Astrofizicheskaya Observatoriya (1971).

Topics discussed include: the definition of astronomical disciplines, basic astronomical terminology, notion of a research system, and characterization of galactographic research. (W.D.M.)

51297 STELLAR-STATISTICAL PROBLEMS. II. GENERAL CONSIDERATIONS ABOUT THE DESCRIPTIVE BACKGROUNDS FROM STELLAR-STATISTICAL VIEWPOINT. Eelsalu, H. pp 15-20 of Stellar-Statistical Problems. /Eelsalu, H. Tartu; Tartuskaya Astrofizicheskaya Observatoriya (1971).

Topics discussed include: descriptive backgrounds, basic characteristics of backgrounds, problem of simplicity of backgrounds, and basic astronomical considerations. (W.D.M.)

51298 ABSORPTION COEFFICIENT IN ATMOSPHERES OF M STARS. Kipper, T. (Inst. of Physics and Astronomy, Tartu). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 20: No. 4, 426-31(1971). (In Russian).

A method for calculating the continuous absorption coefficient in cool stellar atmospheres is treated. Infrared bands of some important molecules are taken into account. Convenient formulae are found for computer use. (auth)

51299 SPECTROGRAPHIC AND PHOTOMETRIC OBSERVATIONS OF SUPERGIANTS AND FOREGROUND STARS IN THE DIRECTION OF THE LARGE MAGELLANIC CLOUD. Ardeberg, A.; Brunet, J.-P.; Maurice, E.; Prevot, L. (Marseille Observatory). Astron. Astrophys., Suppl. Ser.; 6: No. 3, 249-309 (Jul 1972).

UBV photometry and slit spectra of intermediate dispersion (74 Å mm^{-1}) were obtained at La Silla for 409 stars belonging to the Large Magellanic Cloud, for 42 possible LMC members, and for 132 galactic foreground stars among which 19 have high radial velocities. The stars were selected at the Marseille Observatory from plates taken with the objective-prism radial velocity astrograph of the European Southern Observatory. V magnitudes, (B–V) and (U–B) color indices, MK spectral types and radial velocities are presented. Remarks are given concerning the positions, spectral types, magnitudes, and colors. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 51264, 51373, and 51510.

51300 (NP–19402) RELATIVISTIC PLASMA AND THE MECHANISMS OF PULSARS EMISSION. Preprint No. 44. Kaplan, S. A.; Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1972. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

A model is presented for the pulsar radiation mechanism, and the properties of the associated ultrarelativistic plasma are discussed. (W.D.M.)

51301 DISTANCES TO THE QUASARS. Schmidt, M. (California Inst. of Tech., Pasadena). Quart. J. Roy. Astron. Soc.; 13: No. 2, 297-302(Jun 1972).

The distances to the quasars are stated to be less certain than other astronomical distances. The distance scale usually adopted is based on the cosmological interpretation of the redshift. Some astronomers prefer a "local hypothesis" in which the quasars are at much smaller distances, usually by a factor of 100 to 1000. Various hypotheses of the nature and origin of quasars are examined. It is concluded that there is little solid evidence as to the distance scale of quasars, except for the association of a quasar with a galaxy of the same redshift. (UK)

51302 GAIN PARAMETERS OF INTERSTELLAR MASERS. Selden, A. C. (Culham Lab., Abingdon, Eng.). Phys. Lett., 40A: No. 5, 355-6(14 Aug 1972).

The OH and H_2O masers at the boundaries of H II regions are only partially saturated even for large solid angle. The conditions on H_2O are more stringent than for OH emission. (auth)

51303 CORONAL BROADENING OF THE CRAB NEBULA 1969-71. Blesing, R. G.; Dennison, P. A. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 84-6(Mar 1972).

A brief outline of 3 years of observations of the Crab Nebula at 80 MHz during its near-occultation by the Sun is presented. The derived values for radial and tangential broadening are discussed in relation to previous work. (Australia)

51304 CORONAL BROADENING OF THE CRAB NEBULA 1969-71 INTERPETATION. Dennision, P. A.; Blesing, R. G. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 86-88 (Mar 1972).

Observations of coronal broadening of the Crab Nebula are examined in terms of various scattering models. A discussion of the variation of axial ratio of the plasma irregularities is given. Values of the ratio of the scattered distribution obtained by fitting an elliptical Gaussian to observed distributions gave a constant value of about 2:1 for $r > R_\odot$. For $r < R_\odot$ there is a tendency for the elongation to increase to about 3 or 4:1 at $r \sim 5R_\odot$. No evidence was found of deviation of the elongated irregularities from the radial direction. (Australia)

51305 INTERPLANETARY SCINTILLATION STUDIES AT THE MOLONGLO RADIO OBSERVATORY. Milne, R. G. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 2: No. 2, 88-9(Mar 1972).

Radio source scintillation results for 0518 + 16 are scintillation index $M \simeq 0.23$, modulation power $\simeq 0.06$, first moment $\simeq 0.6$ Hz, second moment (square root) $\simeq 0.8$ Hz. (Australia)

51306 LONG COHERENCE INTERCONTINENTAL INTERFEROMETRY. Gubbay, J. S. (Weapons Research Establishment, Salisbury, Australia). Proc. Astron. Soc. Aust.; 2: No. 2, 114-15 (Mar 1972).

Observations of 3C 120 and PO727-11 are reviewed. Some trans-Pacific baseline experiments gave comparative error fields and positions for these sources. (Australia)

51307 SEARCH FOR THE OPTICAL COUNTERPART OF CENTAURUS X-3. Peterson, B. A. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 2, 110(Mar 1972).

Plates taken at 4.84 and 4.46 sec revealed no optical counterpart. (Australia)

51308 PHYSICS OF PULSARS. Lenchek, Allen M. (ed.). Topics in Astrophysics and Space Physics. New York; Gordon and Breach, Science Publishers, Inc. (1972). 179p. $14.50.

A separate abstract was prepared for each of the 15 papers presented. (W.D.M.)

For abstracts of individual papers see: 51284 and 51309–51322.

51309 PROBLEMS AND PLEASURES OF PULSARS. Maran, Stephen P. (Goddard Space Flight Center, Greenbelt, Md.). pp 1-7 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

A brief introductory lecture is given on the properties and models of pulsars with emphasis on the Crab pulsar. (W.D.M.)

51310 RADIO OBSERVATIONS OF PULSARS. Huguenin, G. Richard (Univ. of Massachusetts, Amherst). pp 9-19 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

This discussion on radio observations of pulsars is limited to amplitude variations, polarization, and spectra. (W.D.M.)

51311 OPTICAL OBSERVATIONS OF PULSARS. Wampler, E. J. (Univ. of California, Santa Cruz). pp 21-32 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

Following the discovery by Cocke, Disney, and Taylor of the optical counterpart of NP 0532 a number of investigating groups turned their attention to the Crab Nebula pulsar. The results of these investigations from the time of discovery until the Crab Nebula became unavailable for nighttime work in the late spring of 1969 are discussed. (W.D.M.)

51312 X-RAY OBSERVATIONS OF PULSARS. Bradt, Hale V. (Massachusetts Inst. of Tech., Cambridge). pp 33-43 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

The x-ray pulsations from NP 0532, discovered by the NRL group, have been studied by groups at MIT, Goddard, and Rice University. These observations are discussed at some length. (W.D.M.)

51313 MEASUREMENT OF PULSAR PERIODS. Downs, G. S. (California Inst. of Tech., Pasadena). pp 45-55 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

A program for tracking 12 pulsars is briefly described and measurements of the positions and periods are discussed. (W.D.M.)

51314 SEARCHING FOR PULSARS: RESULTS AND TECHNIQUES. Staelin, David H. (Massachusetts Inst. of Tech., Cambridge). pp 57-67 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

Two topics are discussed: techniques of searching for pulsars and a new pulsar model. Searching for pulsars is basically a problem in strategy, for no search can be general. One guesses the emission properties and spatial distribution of pulsars a priori, and this inevitably biases the statistics of the pulsars that are discovered. Various search techniques are reviewed, and an attempt is made to estimate the biases introduced. (W.D.M.)

51315 INTERSTELLAR CLOUD PROPERTIES REVEALED BY PULSARS. Hjellming, Robert M. (National Radio Astronomy Observatory, Green Bank, W. Va.). pp 69-83 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

A discussion is presented on what can be learned about the interstellar medium from various measurements of pulsar radiation. Topics covered include: dispersion measure; hydrogen absorption; average magnetic fields; interstellar scintillation; cosmic-ray ionization; interstellar clouds and a uniform intercloud medium; evidence for a nonuniform intercloud medium; possible sequence for energization of the interstellar medium; and pulsar distances. (W.D.M.)

51316 DISPERSION MEASURES AND DISTANCES OF PULSARS. Terzian, Yervant (Cornell Univ., Ithaca, N. Y.). pp 85-99 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

One of the most informative relations in the discussion of pulsar distances is the dispersion measures of pulsars and their galactic latitude. This relationship is shown for the known pulsars. Topics covered in this review include: the equation for dispersion measure; methods for obtaining pulsar distances; H II regions and dispersion measures; dispersion measure of the Crab pulsar; pulsar distances; and pulsars in other galaxies. (W.D.M.)

51317 ROTATING NEUTRON STARS AND THE NATURE OF PULSARS. Gold, Thomas (Cornell Univ., Ithaca, N. Y.). pp 101-9 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

The pulse radiation mechanism for pulsars is considered, and it is concluded that a rotating neutron star best fits the observational phenomena and makes for a neater theoretical package. (W.D.M.)

51318 NEUTRON STARS, PULSAR RADIATION, AND SUPERNOVA REMNANTS. Pacini, F. (Cornell Univ., Ithaca, N. Y.). pp 119-34 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

A pulsar model based upon the rotation of a neutron star with a skew magnetic field is considered. Close to the stellar surface, an electric field of order $E \sim (v/c)B$ causes an outflow of charged particles from the star. These particles are somewhat accelerated in the near magnetosphere and become relativistic ($\gamma = E/mc^2 \gg 1$) close to the speed of light distance $r = c/\Omega$. The pulsed radio emission is connected with an approximate corotational motion and is peaked at the frequency $\Omega\,\gamma^3$. In the case of NP 0531, the observed intensity of emission requires a density of order 10^{11} cm^{-3}, a Lorentz factor $\gamma \sim 200$ and a correlation length of about 10 cm. The optical and the x-ray emission from NP 0531 can be explained as a concomitant synchrotron radiation by the same particles in a field $B \sim 10^6$ gauss. The low-frequency cutoff at about 10^{15} Hz is predicted by the theory of synchrotron reabsorption and can be taken as a proof for an emission close to the speed of light distance. The same particles responsible for the pulsar radiation can be accelerated further at $r > c/\Omega$, and they become responsible for an eventual high-energy activity in the remnant. Some evolutionary considerations about this activity are finally developed. (auth)

51319 PULSARS: ROTATING MAGNETIC NEUTRON STARS. Chiu, Hong-Yee (Goddard Space Flight Center, New York). pp 135-50 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

An account is presented of a theory of pulsar radio emission. The emission mechanism is via maser amplification process. This theory avoids the difficulty of coherent plasma emission, that the bandwidth of radiation must be less than $\lambda/2$. The high-brightness radio temperature and the insensitivity of pulsar radio flux to pulsar periods can be easily accounted for. (auth)

51320 MAGNETOSPHERE THEORY OF PULSAR ELECTRODYNAMICS. Goldreich, Peter (California Inst. of Tech., Pasadena). pp 151-8 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

The magnetosphere theory of pulsar electrodynamics is considered by first discussing the unipolar inductor, for example, an iron sphere, uniformly magnetized with magnetization parallel to the rotation axis. The physics of a neutron star rotating in a vacuum is developed. (W.D.M.)

51321 PULSARS AND THE ORIGIN OF COSMIC RAYS. Ostriker, J. P. (Princeton Univ., N. J.). pp 159-70 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

A theory of the Crab pulsar is developed and particle emission from neutron stars is discussed. The evolution of pulsars is considered. (W.D.M.)

51322 APPROXIMATE PARAMETERS OF 55 PULSARS. Modali, S. B.; Maran, S. P. (Goddard Space Flight Center, Greenbelt, Md.). pp 171-3 of Physics of Pulsars. /Lenchek, Allen M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

The names, periods, equatorial coordinates (epoch 1950), and dispersion measures are given in an accompanying table for the 55 pulsars announced as of September 1970. The available data on pulse widths are so inhomogeneous that they were left out. From time to time, lists of pulsars with these and other parameters given to the precision of the available observations are published in Earth and Extraterrestrial Sciences. (auth)

51323 FLUX DENSITIES OF DISCRETE RADIO SOURCES AT 3.5 cm. Andrievskii, A. E.; Spangenberg, E. E.; Val'tts, I. E.; (and others). Izv. Krym. Astrofiz. Observ.; 43: 30-6 (1971). (In Russian).

The results of measurement of the flux density of 130 discrete radio sources at 3.5 cm are given. Observations were made with the 22-meter radiotelescope of the Crimean observatory in August–September 1968. (auth)

51324 3C 323.1:A QSO IN A RICH CLUSTER OF GALAXIES. Oemler, Augustus Jr.; Gunn, James E.; Oke, J. B. (California Inst. of Tech., Pasadena). Astrophys. J.; 176: No. 2, L47-50 (1 Sep 1972).

The QSO 3C 323.1 is at a projected distance of 6.5′ from the center of a compact Zwicky cluster and has the same redshift as the cluster. The cluster is investigated and found to be a typical cluster of richness 1 on Abell's scale. The probability of a chance coincidence is small. (auth)

51325 FURTHER SEARCHES FOR THE PULSAR IN VELA. Lasker, Barry M.; Bracker, Stephen B.; Saa, Oscar (Cerro Tololo Inter-AMERICAN Observatory, La Serena, Chile). Astrophys. J.; 176: No. 2, L65-7(1 Sep 1972).

Several stars and apparently empty fields near the 1971 NRAO interferometric position for the Vela pulsar (PSR 0833−45) were searched for optical pulsations. The results, all negative, are presented. (auth)

51326 INFRARED OBSERVATIONS OF VARIABLE RADIO OBJECTS. Rieke, G. H. (Univ. of Arizona, Tucson). Astrophys. J.; 176: No. 2, L61-3(1 Sep 1972).

BL Lacertae, OJ 287, AP Lib, B2 1212 + 30, and ON 231 were observed in the infrared; the first three were detected. BL Lacertae and OJ 287 showed infrared variations which, at least for OJ 287, correlated with the long-term variations observed in the optical and radio regions. (auth)

51327 INTERSTELLAR HYDROGEN SULFIDE. Thaddeus, P. (Goddard Inst. for Space Studies, New York); Kutner, M. L.; Penzias, A. A.; Wilson, R. W.; Jefferts, K. B. Astrophys. J.; 176: No. 2, L73-6(1 Sep 1972).

The $1_{10} \rightarrow 1_{01}$ transition of H_2S at 168.7 GHz was detected in seven Galactic sources. Hydrogen sulfide is about as abundant as H_2CO, having column densities in the range 0.4 to 5×10^{14} cm^{-2}. (auth)

51328 INTERSTELLAR NITROGEN-15 AND U169.3: POSSIBLY A NEW METHANOL LINE. Wilson, R. W. (Bell Telephone Labs., Holmdel, N. J.); Penzias, A. A.; Jefferts, K. B.; Thaddeus, P.; Kutner, M. L. Astrophys. J.; 176: No. 2, L77-9(1 Sep 1972).

The $J = 2 \rightarrow 1$ lines of $H^{13}C^{14}N$ and $H^{12}C^{15}N$ have been detected in the Ori A infrared nebula. These yield an isotopic abundance ratio $b/a = (^{14}N/^{15}N)/(^{12}C/^{13}C)$ of 2.6 ± 0.8, in agreement with the terrestrial value 3.11, and hence strong evidence that the carbon and nitrogen isotopic ratios a and b have separately their terrestrial values. A new line has also been found in the infrared nebula whose rest frequency, if one assumes an LSR radial velocity of 8.5 ± 1.0 km s^{-1}, is 169336.1 ± 0.7 MHz; it is possibly the $J = 10$, $K = 1-0$ transition of the E_1 symmetry species of methanol. (auth)

51329 TECHNIQUES IN BALLOON X-RAY ASTRONOMY. Peterson, L. E.; Pelling, R. M.; Matteson, J. L. (Univ. of California, San Diego, La Jolla). Space Sci. Rev.; 13: No. 2, 320-36(Jun 1972).

The first balloon observation of a cosmic x-ray source, the Crab Nebula, was made in 1965, only three years after the initial discovery of such sources by rocket observations. Since then balloon data has provided much information on the positions, spectra, time variability and pulsed nature of localized sources, and on the spectrum and isotropy of diffuse galactic and universal components. Measurements are limited to energies above about 20 keV by atmospheric attenuation at 2 to 3 g cm^{-2} depth and to below several hundred keV by detector sensitivity. Detectors usually consist of large area NaI or CsI scintillation counters with anticoincidence collimators for rejection of charged particles and scattered x rays. Proportional counters are occasionally used at lower energies and solid state detectors are used where extreme energy resolution is important. The instruments require a pointing capability on the order of 1.0 to 0.1°, depending on the collimator aperture. Digital data is either recorded on board or telemetered using a PCM technique. Exploratory work in the 0.2- to 10-MeV γ-ray range is starting now, and balloon observations may be expected to make important contributions in the near future. (auth)

Solar Phenomena

Refer also to abstracts 51257, 51434, 51435, 51495, and 51498.

51330 (AD–736463) MAGNETIC AND VELOCITY CONFIGURATIONS IN THE SOLAR ATMOSPHERE. Final Report, November 15, 1969–May 14, 1971. Dennison, Edwin W.; Howard, Robert F. (California Inst. of Tech., Pasadena). 4 Aug 1971. Contract F19628-70-C-0133. 10p. (AFCRL–71-483). NTIS.

A powerful data-reduction system has been constructed to aid in the solution of important problems involving magnetic and velocity fields on the surface of the Sun. In the near future this system, coupled to telescope control and data acquisition systems now being built, will be moved to the 150-foot solar tower telescope at Mount Wilson where it will provide astronomers with a powerful new tool for research in solar physics. (auth) (NTIS)

51331 (AD–738925) DIRECT OBSERVATIONS OF LOW-ENERGY SOLAR ELECTRONS ASSOCIATED WITH A TYPE-III SOLAR RADIO BURST. Frank, L. A.; Gurnett, D. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Feb 1972. Contract N00014-68-A-0196-0003. 56p. NTIS.

Direct observations of the impulsive ejection of a high anisotropic, low-energy solar electron packet accompanied by a Type-III solar radio noise burst detected simultaneously with instrumentation on the satellite IMP 6 were examined. These events were associated with a solar flare commencing at 0935 UT, April 6, 1971, on the western limb of the Sun. (NTIS)

51332 EFFECT OF SCATTERING ON SOLAR RADIO SOURCES AT 80 MHz. Riddle, A. C. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 2, 98-100(Mar 1972).

Effects on observable source properties produced by refraction and scattering by anisotropic density inhomogeneities, randomly distributed in an otherwise spherically symmetric corona, are investigated. Results are presented for source duration, position shift, radial and transverse dimensions, directivity and source size for several parameters at a frequency of 80 MHz. These are compared with current theories and actual observations of type-III bursts. (Australia)

51333 MODEL OF THE EVOLUTION OF THE FLUX DENSITY AND POLARIZATION IN ISOLATED MOVING TYPE IV BURSTS. Schmahl, E. J. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 2, 95-8(Mar 1972).

In the first 4 years of operation with the 80-MHz heliograph at Culgoora, 24 events classified as moving type IV were observed. Their characteristics can be interpreted in terms of gyro-synchrotron radiation from mildly relativistic electrons. Two recent events, distinguished by their simplicity, involve completely isolated sources that moved far above the 80-MHz plasma level. Flux density and polarization exhibit certain variations with time that are typical of all isolated moving Type-IV events. Their properties are described with a simple quantitative model, which is consistent with them and allows prediction of spectral behavior. Future heliograph observations at multiple frequencies will provide a severe test and may allow quantitative determinations of electron densities, energies, and magnetic fields in the sources of moving Type-IV bursts. (Australia)

51334 TEMPERATURE OF THE SOLAR PHOTOSPHERE-CHROMOSPHERE TRANSITION REGION. Carver, J. H.; Horton, B. H.; Lockey, G. W. A. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 94-5(Mar 1972).

Measurements made using an ion chamber in satellite WRESAT I gave a value of 4590 ± 50°K associated with the wavelength range 1570 to 1680 Å. (Australia)

51335 EFFECT OF A MAGNETIC FIELD ON FINITE AMPLITUDE CONVECTION. Murphy, J. O.; Spiegel, E. A.; Van Der Borght, R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 2, 93-4(Mar 1972).

The locus of maximum Nusselt number is shifted to larger horizontal wave numbers with increasing strength of the magnetic field. This effect becomes more marked at the high Rayleigh number which would apply in astrophysical application such as the solar convective layer. (Australia)

51336 EFFECT OF ROTATION ON THERMAL CONVECTION. Murphy, J. O.; Van Der Borght, R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 2, 92-3(Mar 1972).

Small values of the Taylor number have little effect on the maximum heat transfer but this maximum is shifted to a higher wave number. At large Taylor number rotation substantially reduces the maximum value of the Nusselt number, which consequently occurs at a small cell size. This can be related to the solar convection zone. (Australia)

51337 MODEL OF THE SOLAR CONVECTION ZONE. Waters, B. E.; Van Der Borght, R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 2, 92(Mar 1972).

The temperature profile in the uppermost region is derived from finite-amplitude convection theory using the Boussinesq approximation. (Australia)

51338 SOUTHERN HEMISPHERE RADIO METEOR ORBIT SURVEY. Gartrell, G. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 89-90(Mar 1972).

Radiants and velocities of individual meteors down to limiting radio magnitude = +8 were measured at 27 MHz. The existence of a concentration centered on the longitude of the apex at ecliptic latitude −60° was confirmed. Surface area-to-mass ratios for each meteor were determined and showed a definite dependence on height of detection. A stream search showed 40% of the orbits were associated with at least one other orbit and 30% were associated with two or more. (Australia)

51339 BESSELLIAN SPECTRAL ANALYSIS OF INTERPLANETARY SCINTILLATION. Ward, B. D.; Blesing, R. G.; Dennison, P. A. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 82-4(Mar 1972).

The dependence of observed power spectrum modulation on various solar-wind parameters, in particular the distance of the scattering region from the observer, the thickness of the scattering layer, and the presence of other than a single well-defined velocity, is examined. Some observations of scintillation at 80 MHz that have been analyzed are discussed. (Australia)

51340 RELATIVE POSITIONS OF FUNDAMENTAL AND SECOND HARMONIC TYPE III BURSTS. Stewart, R. T. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 2, 100-1(Mar 1972).

Previous workers have reported type-II and type-III bursts in which the observed positions can be interpreted to favour backward emission of the second harmonic in a smooth corona. The harmonic is seen after reflection from near the fundamental plasma level. Further evidence is now presented from a large number of type-III bursts observed with the 80-MHz heliograph and 158-MHz interferometer. The study refers to type-III bursts for which a clearly defined fundamental followed by a second harmonic several seconds later was recorded. Harmonic structure was identified from spectrograms in the 20- to 200-MHz range. Only the relative positions of the fundamental and harmonic components are discussed; detailed observations will follow. These results are consistent with backward emission of the second harmonic assuming radial outward movement along the axis of a coronal streamer with electron density about twice that derived by Newkirk. A scattering process to account for the observed relative positions is discussed. (Australia)

51341 CORONAL SITE OF A TYPE III BURST AS A SOURCE OF INTERPLANETARY ELECTRONS. Palmer, I. D. (CSIRO, Sydney); Lin, R. P. Proc. Astron. Soc. Aust.; 2: No. 2, 101-3 (Mar 1972).

Detection of interplanetary electrons near the Earth is related to the radioheliograph observation of a group of type-III bursts in the eastern quadrant of the Sun. Implications are discussed for the propagation of electrons between these two points in space, as well as for the extent of the electron source region in the corona. (Australia)

51342 SOLAR RADIO OBSERVATIONS OF THE PROTON EVENT OF 1971 JANUARY 24. Palmer, I. D.; Smerd, S. F.; Riddle, A. C. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 2, 103-5(Mar 1972).

A 3B flare at 18°N, 49°W was associated with the acceleration of protons to relativistic energies, one of the rare events recorded by ground-level neutron monitors. Time sequence and positions of the solar radio bursts are related to times and places where the energetic particles were accelerated and injected onto interplanetary field lines. Radio data showed that there were two separate explosive events, identified by flash phases, 10 min apart. Both explosions gave rise to coronal shock waves, which propagated in quite different directions. Microwave observations indicated that particle acceleration to relativistic energies was associated with the first, while subsequent particle release occurred during the second event. It is proposed that the second shock wave enabled release of the relativistic particles on to interplanetary field lines connected to the Earth. (Australia)

51343 SCIENTIFIC MEETING OF THE ASTRONOMICAL SOCIETY, OBERKOCHEN, GERMANY, APRIL 13–16, 1971. Mitt. Astron. Ges.; No. 30, 1-168(1971). (In German). (CONF-710449).

Topics summarized include a description of the equipment and results obtained at the European Southern Observatory in Chile, gravitational phenomena in spiral galaxies, the measurement of the proper motion of stars, the origin of the solar magnetic field, and the formation of sunspots. Other papers described the 1.2-m telescope of the Max Planck Institute of Astronomy, a ballistic measurement chamber system for photographing satellites, and a so-called tridrant star sensor. Also included are articles on the effects of temperature variations on optical lens systems, the determination of the ratio between interstellar extinction and discoloration, images of the Sun in the euv and soft x-ray region, observations of red stars in the Cygnus constellation, the presence of hydrogen in comets, a possible extrasolar effect on solar activity, the existence of a homogeneous intergalactic field, and the contribution of O and B stars to the electron density in the vicinity of the Sun. Separate abstracts were prepared for two full-length papers. (IAA)

For abstracts of individual papers see: 51344 and 51364.

51344 THEORY OF THE SOLAR MAGNETIC FIELD. Deinzer, W. (Univ., Goettingen, Ger.). Mitt. Astron. Ges.; No. 30, 67-74(1971). (In German).

From Scientific meeting of the Astronomical Society; Oberkochen, Germany (13 Apr 1971).

A theory combining differential rotation and the α effect to explain the solar magnetic field cycle and phenomena associated with it is presented. (J.S.R.)

51345 ROTATIONAL ANALYSIS OF THE $A^1\Sigma^+ \rightarrow X^1\Sigma^+$ AND $B^1\Pi \rightarrow X^1\Sigma^+$ SYSTEMS OF $^{24}MgH^+$, $^{25}MgH^+$, AND $^{26}MgH^+$. Balfour, W. J. (Univ. of Victoria, B. C.). Can. J. Phys.; 50: No. 11, 1082-91(1 Jun 1972).

Previous analyses of the $A^1\Sigma^+ - X^1\Sigma^+$ and $B^1\Pi - X^1\Sigma^+$ systems of $^{24}MgH^+$ were extended. Dunham coefficients and RKR potential energy curves were determined for the A and X states. Franck–Condon calculations based upon these curves show improved agreement between theory and experiment for the A–X transition. Measurements on the stronger bands of $^{25}MgH^+$ and $^{26}MgH^+$ are also reported. (auth) (Canada)

51346 THEORY OF TRANSFER RADIATION IN MAGNETIC FIELD. Rachkovskii, D. N. Izv. Krym. Astrofiz. Observ.; 43: 190-200(1971). (In Russian).

The formation of absorption lines in a weak magnetic field is considered. Taking into account the phase correlation of the radiation emitted from different sublevels, a scattering matrix is deduced. The scattering matrix can be brought to a form of the product of two mutually inverse matrices, depending on the angles between the directions of incident and scattered beams, respectively, with the magnetic field. It is shown that the method obtained previously (1967) can be used for the solution of transfer equations. (auth)

51347 LOCATION OF THE CONTINUOUS EMISSION REGIONS OF THE SOLAR FLARES. Steshenko, N. V. Izv. Krym. Astrofiz. Observ.; 43: 130-51(1971). (In Russian).

The location of the continuum emission in the spectra of 47 flares observed with the tower solar telescope of the Crimean astrophysical observatory was measured. It was found that in most cases the continuum emission of flares appears in regions of the flare other than emission line regions. This difference in the position of continuum and linear emission depends mainly not on the difference in the height of the emitting regions, but on the horizontal division of these regions, i.e., along the solar surface. None of the continuum emission regions (of the 10 observed at least) coincided with the most active regions of disk flares with He I and He II emission lines. The following mechanism of the continuum emission appearance in some types of flares is proposed: the plasma jet, which moves with velocity about 100 km/sec from the flare region, emitting the lines, can hit the photosphere at some distance from the flare. The kinetic energy of this jet, $\sim 8 \times 10^9$ erg/cm$^2 \cdot$ sec, is enough to increase the temperature of the certain part of the photosphere up to 6600 to 6700°K, that leads to the appearance of the continuum emission observed. (auth)

51348 COMPARISON OF PHYSICAL CONDITIONS IN PROTON AND NONPROTON FLARES. Steshenko, N. V. Izv. Krym. Astrofiz. Observ.; 43: 152-6(1971). (In Russian).

Available data on physical conditions in 16 proton and 54 nonproton flares are compared. None of the main characteristics (n_e, T_e, N_2) of proton flares is found to have essential difference in comparison with those of nonproton ones. A comparison of Hα line width in 142 flares (of importance 2^+, 3, 3^+), 57 of which are proton flares, does not show qualitative differences between proton and nonproton flares. (auth)

51349 MOTIONS OF TWO DETAILS IN THE CHROMOSPHERIC FLARE KNOTS. Ogir, M. B. Izv. Krym. Astrofiz. Observ.; 43: 157-64(1971). (In Russian).

Using spectrograms and Hα films, the motions of two details of a flare branch in three chromospheric flares are considered. It is shown that the radial velocities of both details of a single flare knot often differ in size and direction. In the flare of July 25, 1959 the motion of both details seems to be rotational and probably spiral in form, but the velocity of this spiral motion is different for each detail. In the loop flare of Oct. 25, 1960 extension followed by descent and the simultaneous spread of the matter from the bright top were observed. The radial velocities of both details were rather similar. In the stage of fading their motions became different. In the flare of July 20, 1959 both centers didn't form a loop, and the radial velocities of both details were considerably different. It is pointed out that the complex picture of motions observed in flares may be due to respective motions of both details and macroscopic inner motions in each of them. (auth)

51350 CONNECTION OF THE MOTIONS OF CHROMOSPHERIC FLARES AND SURGES WITH THE MAGNETIC FIELD. Ogir, M. B. Izv. Krym. Astrofiz. Observ.; 43: 165-73(1971). (In Russian).

The motions of flare sprays and loops relative to the transverse magnetic field are discussed. The existence of close conformity between the direction of this motion and that of the transverse component of the magnetic field is shown. The extension of the flare matter is observed when the transverse field promotes this motion. The nonsimultaneous formation and extension of flare knots correspond to the nonsimultaneous change of the magnetic field in the flare knot region. The extension of the flare matter observed in some cases conforms to the direction of the transverse field, recorded considerably later than the flare. This phenomenon is compared with that for the surge activity. The position of the surge activity regions corresponds to the field, which will appear in one or some days. The surge activity may arise long before the field appeared or changed. On these grounds the extension of the flare matter is assumed due to the development of surges in the flare knot region. (auth)

51351 FIELD OF VELOCITIES AND BRIGHTNESS IN THE SOLAR ATMOSPHERE. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 43: 174-89(1971). (In Russian).

The field of velocities and brightness in active and quiet regions of the Sun was studied. The recordings of radial velocities and brightness were made in the Fe I λ5250 Å, Ca I λ6103 Å, Hβ, Hα, and K$_3$ Ca II lines with the double magnetograph. It is shown that there is a good correlation between the brightness at different levels in the solar atmosphere. The brightest places of the plage knots as observed in the K$_3$ Ca II, Hα, Hβ, Fe I λ5250 Å, and Ca I λ6103 Å lines as well as bright knots of the chromospheric network in K$_3$ Ca II line coincide with the neutral line of the radial velocity or lie near it. In the places of the highest brightness of plage knots neutral lines of photospheric and chromospheric radial velocities coincide as a rule. But the motions close to these neutral lines may have the same or different directions in the photosphere and chromosphere. The features of motions at different levels of the atmosphere are not in good agreement with those in the supergranulations. The plage knot brightness does not depend on the compression or expansion of the gas surrounding the neutral line which coincides with this knot. The correlation between the plage knot brightness and the gradient of radial velocity is found. There is reason to suppose that the Ohmic losses may be important for the heating of the plages. (auth)

51352 OBSERVATIONS OF CIRCULAR POLARIZATION OF SOLAR RADIO EMISSION AT 3.15 cm. Eryutsev, N. N.; Tinin, M. V.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 43: 3-16(1971). (In Russian).

Observational results of circular polarization of local sources and bursts at 3.15 cm are given. The observations were made with the 22-meter radio telescope at the Crimean observatory during June—July, 1968. It was confirmed that the polarized emission has its directivity. However, the polarized emission may be observed when an active region is either on the limb or behind it. From the observations of two behind-the-limb sources it was established that the upper boundary, where the polarized emission is generated, is at the heights 16×10^3 km and 35×10^3 km above the photosphere. The higher altitude corresponds to a more powerful source. It is shown that the polarized emission source associated with the unipolar active region (in the South hemisphere) is displaced from the sunspot approximately by 20 to 30″ to the northwest. During the radio bursts of July 10 and 12, 1968 the sign change of polarization was recorded. On July 12, 1968 the changes of intensity of polarized radio emission were observed some hours before the burst. The periodic variations (oscillation type) of polarized emission were found during the burst itself. (auth)

51353 COMPARISON OF TIME PROFILES OF TYPE IV BURSTS AT 1.5 METERS WITH THE TOTAL FLUX OF H$_\alpha$ EMISSION. Yurovskaya, L. I.; Yurovskii, Yu. V. Izv. Krym. Astrofiz. Observ.; 43: 17-20(1971). (In Russian).

The time profiles of six Type-IV bursts are considered. The curves of total flux of Hα emission were obtained for corresponding flares. In some cases the profiles of Type-IV bursts at 1.5 meters coincided with those of the total flux of Hα emission. The conclusion is made that the emission of neutral hydrogen is associated with the mechanism of the acceleration of particles responsible for synchrotron emission of Type-IV bursts. (auth)

51354 OBSERVATIONS OF THE SOLAR RADIOEMISSION AT 8.13 AND 16 mm. Efanov, V. A.; Moiseev, I. G. Izv. Krym. Astrofiz. Observ.; 43: 21-5(1971). (In Russian).

The observation results of the solar radio emission within the range 8 to 16 mm are given. The observations were made with the 22-meter radio telescope at the Crimean observatory. Brightness temperatures of the undisturbed Sun (7950 ± 500, 9700 ± 600, and 11,750 ± 700°K) at 8.1, 13.2, and 16.6 mm, respectively, were found, and the frequency spectra of six local sources were determined. The brightness temperatures of these sources increased in proportion to the wavelength, while the flux density decreased with the wavelength. The dimensions of the sources were 1 to 5 minutes of arc. (auth)

51355 RADIOASTRONOMICAL OBSERVATIONS IN THE RANGE 0.9 TO 1.5 mm WITH THE 22-METER RADIOTELESCOPE AND THE RECEIVER MADE OF n-InSb. Vystavkin, A. N.; Efanov, V. A.; Listvin, V. N.; (and others). Izv. Krym Astrofiz. Observ.; 43: 26-9(1971). (In Russian).

The 22-meter radio telescope of the Crimean observatory and the n-InSb receiver were used for the observations of solar radio emission in the range 0.9 to 1.5 mm. The local sources of radio emission of the Sun were found. (auth)

51356 THERMAL OSCILLATIONS IN THE HIGH SOLAR PHOTOSPHERE. Noyes, Robert W. (Smithsonian Astrophysical Observatory, Cambridge, Mass.); Hall, Donald N. B. Astrophys. J.; 176: No. 2, L89-92(1 Sep 1972).

Prominent 5-minute oscillations have been detected in the intensity of the fundamental vibration—rotation lines of CO at 4.67 μ. These lines are formed near the temperature minimum in the high photosphere, where the thermal response to density fluctuations is nearly adiabatic. The intensity amplitude corresponds to a temperature oscillation with peak-to-peak amplitude of 225°K. (auth)

51357 INSTRUMENTATION FOR BALLOON AND ROCKET EXPERIMENTS. Anderson, K. A. (Univ. of California, Berkeley). Space Sci. Rev.; 13: No. 2, 337-60(Jun 1972).

A number of plasma, particle, and field detectors used on rocket investigations in and above the Earth's atmosphere are described. Emphasis is on magnetospheric and solar-interplanetary studies. A balloon-borne x-ray telescope system with 20′ pointing accuracy is discussed. A PCM telemetry system used on both balloons and rockets to handle scientific data is described including a simple Doppler ranging system that gives location to 1.5 km. A system to reduce and analyze PCM data on the ground is discussed. (auth)

Galaxies

Refer also to abstracts 51269, 51273, 51343, and 51909.

51358 INFRARED PHOTOMETRY OF MARKARIAN 231. Young, E. T.; Knacke, R. F.; Joyce, R. R. (State Univ. of New York, Stony Brook). Nature (London); 238: No. 5362, 263(4 Aug 1972).

Observations of Markarian 231 in the infrared are described, with a view to gaining a better understanding of the energy omitted by this object. The object is a Seyfert galaxy with a very luminous nucleus, rather like that of QSOs. The observations were made in May 1972 with a liquid He cooled, Ga-doped Ge bolometer at the 60 inch Tillinghast reflector of the Smithsonian Astrophysical Observatory. No radio source was found at the position of Markarian 231. The flux between 8 and 14 μ was found to be 1.8×10^{-13} W/m^2, giving a power of 1.2×10^{45} ergs/s based on a redshift of 0.041 and a Hubble constant of 50 km/s/Mpc. This power is greater than the total luminosity of the galactic center by a factor of 3.8×10^3, and Markarian 231 is the most luminous galaxy yet observed. The observations also provide additional support for the hypothesis that similar physical processes are taking place in the nuclei of galaxies and in QSOs. (UK)

51359 CLASSICAL CEPHEIDS: CORNERSTONE TO EXTRAGALACTIC DISTANCES. Sandage, A. (Carnegie Institution of Washington, D. C.). Quart. J. Roy. Astron. Soc.; 13: No. 2, 202-21(Jun 1972).

Cepheid variables form the most important component of the foundations to galaxy distances. The current state of knowledge of the Cepheid phenomenon is examined. Seven topics are considered: the shape of the mean P—L relation, the need for a third parameter developed through a heuristic account of the intrinsic dispersion of P—L, the absolute calibration of P—L—C, the uniqueness of the relation "throughout the Universe," amplitude of variation at various positions within the Cepheid instability strip, the question of a fourth parameter, errors in the Cepheid calibration. With the proviso that the fourth parameter does not affect Cepheid absolute magnitudes, available evidence is consistent with assigning high weight to extragalactic distances derived from Cepheids. No evidence is known which would indicate that systematic errors will occur from galaxy to galaxy, although there may be systematic errors in the present calibration of the zero point. From other comparisons (e.g., RR Lyrae), it seems likely that such systematic errors may not be larger than $\simeq 0.3$ mag, and, therefore, that photometric distances to galaxies containing Cepheids can perhaps be obtained now to within ±15%. (UK)

51360 SPIRAL AND HALO STRUCTURE OF OUR GALAXY ON THE BASIS OF OPTICAL DISTANCE DETERMINATIONS. Becker, W. Quart. J. Roy. Astron. Soc.; 13: No. 2, 226-40 (Jun 1972).

Application of three-color photometry to stellar statistics is reviewed, in relation to galactic clusters, distribution of stars in the galactic disk, and distribution of stars in the galactic halo. The method of distance determination of galactic clusters is demonstrated, using as an example the cluster NGC 457, which was observed photoelectrically by Pesch (Astrophys. J., 130: 764(1959)). Applying three-color photometry to star fields in the galactic disk, a description is given of the use of the two-color diagram to get absolute magnitudes and color excesses for the stars involved. The main sequence of the two-color diagrams is calibrated in luminosities with the help of galactic clusters and stars with known parallaxes. The medium- and late-type giants play an important role in stellar statistics, because they often happen to be more numerous than main-sequence stars of the same luminosity. Comparing the two-color diagrams for different galactic fields and for different distances, the distribution of the stars on the main sequence and in the giant region can vary considerably. From the available density functions some general conclusions are drawn. In its application to halo-star three-color photometry must be able to measure the uv excess of main-sequence stars caused by low metal content. In the two-color diagrams the disk stars and the halo stars show quite a different behavior. Density functions available for the halo stars are discussed. (UK)

51361 R_0 FROM EXPONENTIAL DISK MODELS. Toomre, A. (Massachusetts Inst. of Tech., Cambridge). Quart. J. Roy. Astron. Soc.; 13: No. 2, 241-2(Jun 1972).

A new indirect estimate of the Earth's distance R_0 from the Galactic center is stated to be $R_0 \cong 8$ or 8.5 kpc, ± at least 0.5 kpc. The deduction rests on the conventional Oort constants $A = 15$, $B = -10$ (km s^{-1})/kpc, and on two further assumptions: (1) the Galaxy is idealized as a thin disk whose z-projected mass density obeys the law $\mu(R) = \mu_0 \exp(-\alpha R)$ at all radii R; and (2) the surface density of that disk near the Sun is taken to be $\mu(R_0) \cong 75\ M_\odot\ pc^{-2}$. The remaining idealized requirement, from the 21-cm rotation data of the interior, is that the excess differential speed at the half-way radius $R = R_0/2$ in any reasonable model be about 105 km s^{-1}. (UK)

51362 V_0 FROM MAGELLANIC CLOUD ORBITS. Toomre, A. (Massachusetts Inst. of Tech., Cambridge). Quart. J. Roy. Astron. Soc.; 13: No. 2, 266-70(Jun 1972).

The postulated close passage of the Magellanic Clouds to the Galaxy roughly 5×10^8 years ago is used as a basis for an estimate, $185 < V_0 < 220$ km s^{-1}, for the rotation speed V_0. It is assumed that the Clouds are close-passing satellites, and yet have not passed very often. It is stated that the most plausible hypothesis appears to be that the orbit period of the combined Clouds was either about 10^{10} or 5×10^9 years, so that their last passage was either their first or second since a common origin. It is assumed, further, that the mean orbit of the passage was retrograde with respect to the rotation of the Galaxy, and, finally, that the local rotation speed V_0 differs no more than 10% from the Keplerian speed $V_K = (GM_G/R_0)^{1/2}$ based on the total mass M_G of the Galaxy and on the supposedly unknown center distance R_0. Orbit formulae were introduced and computations carried out to find that unique radius R_0, for any assumed angular speed $A - B$ and ratio V_0/V_K, for which that lumped Cloud mass with its assigned position and a line-of-sight velocity reduced also by a suitably projected component of the galactic rotation, $V_0 = (A - B)R_0$, would indeed have a period $P =$ say 10^{10} years in an orbit that carries it to a minimum distance $r_p =$ say 20 kpc from the Galactic mass point. (UK)

51363 X-RAY OBSERVATION OF THE LARGE MAGELLANIC CLOUD. Tuohy, I. R. (Univ. of Adelaide); Harries, J. R.; Broderick, A. J.; Fenton, K. B.; Luyendyk, A. P. J. Proc. Astron. Soc. Aust.; 2: No. 2, 111-12(Mar 1972).

Data support the suggestion of x-ray emission from the 30 Doradus Nebula. The x-ray luminosity is $\sim 4 \times 10^{38}$ ergs/sec between 1.5 and 3.9 keV. (Australia)

51364 GRAVITATIONAL EXPLANATION OF THE SPIRAL STRUCTURE OF GALAXIES. Wielen, R. (Astronomisches Rechen-Institut, Heidelberg). Mitt. Astron. Ges.; No. 30, 31-51 (1971). (In German).

From Scientific meeting of the Astronomical Society; Oberkochen, Germany (13 Apr 1971).

The observed spiral structure of galaxies can be satisfactorily explained by the gravitational theory of density waves. No presently known observations oppose this theory significantly, and many previously misunderstood observations can be interpreted by its use. After the elimination of the magnetic field because of too-low field strength, the density waves are the only known mechanism that can explain the long-lived spiral arms. The difficulties still present in the theory are essentially of a theoretical nature. The question of the origin and regeneration of the density waves remains an unexplained problem. (tr-auth)

51365 WAVE NATURE OF THE SPIRAL STRUCTURE OF GALAXIES. I. THE LINEAR THEORY. Marochnik, L. S.; Suchkov, A. A. Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR; No. 58, 3-11(1971). (In Russian).

Spiral density waves are considered in terms of cooperative phenomena in a model galaxy involving differentially rotating and nonrotating subsystems. The latter represent populations I and II of normal spirals, respectively. Due to inherent Landau instability for such a system, the stationary state with excited spiral waves of finite amplitude may be found. According to a proposed hypothesis these waves should be identified with spiral structure of galaxies. A self-gravitating thin disc consisting of differentially rotating interstellar gas and population I and nonrotating population II stars is considered. In the linear approximation the dispersion relation of spiral waves is found. (auth)

51366 WAVE NATURE OF THE SPIRAL STRUCTURE OF GALAXIES. II. THE LINEAR THEORY. Marochnik, L. S.; Suchkov, A. A. Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR; No. 58, 12-22(1971). (In Russian).

Due to the Landau effect a self-gravitating thin disc consisting of differentially rotating population I and nonrotating population II stars is unstable against spiral waves of small amplitude. Leading and trailing spiral waves are dynamically equivalent in respect to instability: they increase with the same increment. The instability is caused by population II stars whose radial component of velocity is close to the radial phase velocity of the wave. The spiral wave rotates with less angular velocity than that of population I stars. From any arbitrary disturbance, asymptotic in time, one spiral mode persists. In addition to Landau instability, the Jeans instability is possible. However, it can not, apparently, lead to formation of spiral arms. The character of Jeans instability essentially differs from that in single-component system. The relative perturbations in densities in different subsystems differ in magnitudes and are phase shifted: each subsystem thus forms its own spiral arms. The same questions were studied for uniform (along z-axis) cylinder consisting of two subsystems as well. Results in this case do not differ qualitatively from those in the case of the thin disc cylinder. The resulting conclusions hold for real systems that are intermediate, in a certain sense, between the two models studied. (auth)

51367 WAVE NATURE OF THE SPIRAL STRUCTURE OF GALAXIES. III. THE NONLINEAR (QUASI-LINEAR) THEORY. Marochnik, L. S.; Suchkov, A. A. Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR; No. 58, 23-34(1971). (In Russian).

The effect of Landau unstable waves on the background and the reverse of slowly changing background density waves is considered. Stars of both types I and II populations diffuse in the velocity space under the influence of growing waves. Owing to the collisions of stars with waves relaxation occurs and entropy grows. The velocity dispersion of population II stars doesn't change markedly, but on the distribution function in the region of radial phase velocity of the wave a plateau is formed. This leads to radial motion of matter. Because of cooperative interaction of subsystems the rotation of a population I star decelerates and transfer of angular momentum from population I to population II stars takes place. The velocity dispersion of population I increases essentially in a short time. The distortion of background leads to a decrease in rate of growth of waves and the system tends to a stationary state, with excited spiral waves of finite amplitude. (auth)

51368 WAVE NATURE OF SPIRAL STRUCTURE OF GALAXIES. IV. THE PHYSICAL INTERPRETATION, THE ASTROPHYSICAL CONCLUSIONS. Marochnik, L. S.; Suchkov, A. A. Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR; No. 58, 35-44 (1971). (In Russian).

The obvious physical considerations illustrating mathematical theory developed in parts I–III are given. Some numerical estimations for the solar neighborhood are made. The spiral waves are unstable. The development of a pattern with 2 to 4 arms from an arbitrary disturbance is possible in 10^8 to 10^9 years. In the same time the system comes to the stationary state with excited waves of finite amplitude. Populations I and II form different spiral arms that are spatially shifted on 200 ps. The relative excess of density in spiral arms of population I is 4 times that of population II. Under the action of spiral waves the radial motion of the local centroid is originated (v = 0.5 to 5 km/sec). This possibly explains the observed vertex deviation. Due to collisions of stars with waves the relaxation of population I occurs in 10^8 to 10^9 years. The same cause leads to angular momentum transfer from population I to population II. However, this effect is weak for the Galaxy, but it must be much more effective for Sc galaxies. (auth)

51369 MULTICOLOR PHOTOMETRY OF THE DOUBLE SYSTEM NGC 5194/5195. Pronik, I. I.; Chuvaev, K. K. Izv. Krym. Astrofiz. Observ.; 43: 101-12(1971). (In Russian).

The prime-focus image converter of the 2.6-meter telescope has been used to take the photographs of the double system NGC 5194/5195. NGC 5195 looks like a bar in red light; in blue the bar brightness is not smooth. NGC 5195 is more red on the whole than the central part of NGC 5194. The outer regions of NGC 5195 are more blue than its central part. The light absorption in the east part of NGC 5195 is 1.5 to 3.5m more than that in other regions. (auth)

51370 INTERPRETATION OF THE RED SHIFT IN THE SPECTRAL LINES OF ASTRONOMICAL BODIES. SUGGESTIONS FOR DIRECT EXPERIMENTS. Pecker, Jean-Claude; Roberts, Alan P.; Vigier, Jean-Pierre (College de France, Paris. Univ., Paris). Compt. Rend., Ser. B; 274: No. 20, 1159-62(15 May 1972). (In French).

Experiments allowing the direct measurement of photon–photon collision cross sections and interaction properties are suggested. A critical analysis of certain published measurements is presented. (France)

Cosmology

Refer also to abstracts 51640, 51906, 51911, 51916, and 51918.

51371 DISTANCES TO GALAXIES. THE HUBBLE CONSTANT, THE FRIEDMANN TIME, AND THE EDGE OF THE WORLD. Sandage, A. (Carnegie Institution of Washington, D. C.). Quart. J. Roy. Astron. Soc.; 13: No. 2, 282-96(Jun 1972).

The Universe expands in such a way that, to better than the observational accuracy of $\sigma\ (\Delta z/z) \simeq 0.1$, the redshift of galaxies is a unique function of distance. The present value of the Hubble constant was obtained from calibration of a new method. A preliminary value of $H_0 \simeq 55 \pm 7$ km s^{-1} Mpc^{-1}, or $H_0^{-1} = (17.7 \pm 2) \times 10^9$ yr is given. The value of q_0 is known to no better than $q_0 = 1 \pm 1$ at the 2 σ level. The Friedmann time for the beginning of the expansion is $H_0^{-1} = 17.7 \times 10^9$ yr for $q_0 = 0$, and is $(10.1 \pm 1.2) \times 10^9$ yr for $q_0 = +1$. Before these can be compared with the age of the oldest stars in the Galaxy, either an observational discovery of the time of galaxy creation in the past, or a model of galaxy formation must be had. If the apparent cut-off of redshifts of quasars near z = 3 is real, one may have already seen the time horizon for the birth of galaxies, although the result is unexpected theoretically. Assuming that the cut-off of quasar redshifts and the explanation for it is real, then the age of the oldest galaxies from the expansion data is $\sim(13.3 \pm 2) \times 10^9$ yr for $q_0 = 0$, and $(9.0 \pm 1) \times 10^9$ years for $q_0 = +1$. The remarkable agreement of these values with the age of globular clusters in the Galaxy, currently suggested to be $T_{G.C.} = (10 \pm 3) \times 10^9$ yr, gives substantial support for Friedmann big-bang cosmologies. The most important next observational step is to test the reality of the apparent redshift cut-off for quasars, and this can be done by means already at hand. (auth)

51372 ABUNDANCE OF HELIUM IN THE COSMOS. I. Hack, Margherita (Astronomical Observatory, Trieste, Italy). Sky Telesc.; 44: No. 3, 164-5(Sep 1972).

One of the major problems in astrophysics is how to interpret the observed amount of helium in the Universe. This question is briefly reviewed and the three possible origins of helium are discussed. Observational approaches and the spectroscopic determination of helium are considered. (W.D.M.)

51373 VIBRATIONAL STABILITY OF SUPERMASSIVE STARS DYNAMICALLY STABILIZED BY A UNIFORM OR DIFFERENTIAL ROTATION. Demaret, J. (Univ., Liege). Bull. Cl. Sci., Acad. Roy. Belg.; 58: No. 1, 68-85(1972). (In French).

The linear e-folding time of pulsation for vibrationally unstable main-sequence supermassive stars (10^5 to 3×10^9 $M_\odot$), dynamically stabilized by a uniform or differential rotation, was calculated using some simplifying assumptions, none of which seems critical. For the most-massive stars, stabilized by a differential rotation (10^8 to 3×10^9 $M_\odot$) which, following Hoyle and Fowler, could represent quasi-stellar objects, the e-folding time of pulsation is of the order of their life time (about 2×10^6 years) in the main-sequence stage, for a large interval of values of the central angular velocity of rotation. So, the phenomenon of vibrational instability cannot affect significantly the hydrogen-burning stage of these stars. Vibrational instability can, however, excite the adiabatic pulsations of some supermassive stars and so explain the optical periodicities observed for certain quasars, like 3C345 and 3C273. If it is sufficiently violent, it can give birth to a stellar wind, which can be the source of the clouds of gas moving outward at very high velocities, which seem to be necessary to explain the multiple absorption redshifts of some quasars. Finally, supermassive stars dynamically stabilized by a differential rotation, but vibrationally unstable, could play an important role in the formation of the helium observed throughout the Universe. (auth)

51374 UNIVERSE EVOLUTION. PART 1. GALAXIES AND THE UNIVERSE. Heidmann, Jean (Observatoire de Paris, Meudon, France). Recherche (Paris); 3: No. 23, 450-61(May 1972). (In French).

Since the beginning of extragalactic astronomy in 1923, observations have been made of normal galaxies regrouped in clusters and superclusters, compact or exploding galaxies, and quasars. As far as it has been probed, the Universe appears to be uniformly populated with clusters of galaxies forming a gigantic expanding cloud. It is now possible to retrace the different stages in the evolution of the Universe from the first second after its creation up to its present 12 thousand million years. (France)

51375 UNIVERSE EVOLUTION. PART 2. THE UNIVERSE AND ANTIMATTER. Omnes, Roland (Univ. Paris, Orsay, France). Recherche (Paris); 3: No. 23, 462-8(May 1972). (In French).

It is sufficient that one thermal nucleon in a million survived in the first instants of the creation of the Universe, to explain the equal quantities of matter and antimatter in galaxies. For the first time, a theory seems possible, which accounts not only for the formation of galaxies, but gives an explanation of the origin of matter and the quantities observed. (France)

51376 CLOSED ROTATING COSMOLOGIES CONTAINING MATTER DESCRIBED BY THE KINETIC THEORY. ENTROPY PRODUCTION IN THE COLLISION TIME APPROXIMATION. Matzner, Richard A. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.); 13: No. 7, 931-7(Jul 1972).

A collision-time approximation for the production of partly collisional particles ("neutrinos") from a collision-dominated fluid ("electrons and photons") within closed anisotropic Bianchi type IX cosmologies is discussed. Two distinct, constant, times are introduced; the neutrino production rate t_e^{-1} is distinct from the neutrino destruction rate t_ν^{-1}. The conservation of energy and momentum is discussed, and it is shown, for a subclass of rotating closed cosmologies and for Maxwell–Boltzmann neutrinos, that the local entropy production rate $s^{\mu}_{;\mu}$ is positive, aside from "rest entropy" terms, i.e., terms representing a fixed amount of entropy permanently attached to each neutrino (which goes out of existence when the neutrino is destroyed and reappears when a neutrino is regenerated). The results here contain as appropriate limits the same conclusions within special relativity and within simpler (Bianchi type I) cosmologies. (23 references) (auth)

51377 WEINBERG MODEL OF THE HOT UNIVERSE. Kirzhnits, D. A. (Inst. of Physics, Lebedev, USSR). JETP Lett. (USSR) (Eng. Transl.); 15: No. 12, 529-31(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 12, 745-8(20 Jun 1972).

In the Weinberg model the masses of the intermediate boson, electron, etc. which hinder the unification of weak interaction with electromagnetism, arise as the consequence of spontaneous symmetry breaking. This model is applied to a large system of weakly-interacting particles at nonzero temperature. Such a system is dealt with, for example, in cosmology, where the "hot" model of the universe is now assumed. (W.D.M.)

51378 ELEMENTARY SPINORIAL EXCITATIONS IN A MODEL UNIVERSE. Ranada, Antonio F. (Univ., Madrid); Soler, Mario. J. Math. Phys. (N. Y.); 13: No. 5, 671-5(May 1972).

The generalized covariant Dirac equation for a certain five-dimensional universe is studied. If a torsion invariant is included in the free Lagrangian, it is shown that particlelike stable solutions exist having definite positive rest energy, spin, and corresponding antiparticles. The treatment is throughout classical. (auth)

51379 CERTAIN GOEDEL TYPE MAGNETOHYDRODYNAMIC UNIVERSES. **Bray, Marcel. Compt. Rend., Ser. A; 274: No. 9, 809-12(28 Feb 1972). (In French).**

Studies of the lines of current in a relativistic fluid by the Ehlers method introduce three tensorial parameters. This method may be advantageously applied to cosmology. (France)

51380 MAXWELL EQUATIONS IN SCHWARZSCHILD'S GRAVITATIONAL FIELD. **Mankin, R.; Piir, I. (Tartu State Univ. Inst. of Physics and Astronomy, Tartu). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 20: No. 4, 413-19(1971). (In Russian).**

The methods and results of a preceding paper (1971) are generalized to the case of electromagnetic radiation. It is shown that because of partial reflection any outcoming electromagnetic wave of arbitrary multipole structure induces a weak incoming radiation in Schwarzschild's spacetime. The laws of reflection for scalar and electromagnetic radiation are identical in the first approximation. (auth)

51381 INHOMOGENEOUS WORLD MODELS AND HIGH-FREQUENCY APPROXIMATION. **Saar, E. (Inst. of Physics and Astronomy, Tartu). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 20: No. 4, 420-5(1971).**

Cosmological models, homogeneous only on the average, were studied by using the high-frequency approximation. It is shown that the density inhomogeneities give rise to an additional energy–momentum tensor, realizing the feedback between the evolution of the structure and the overall dynamics of the Universe. This tensor can be described in terms of a negative "gravitational pressure" and a phenomenological "internal energy." The possible consequences of the results are discussed in brief. (auth)

Planetary Phenomena

51382 PLASMA SHEET AT LUNAR DISTANCE: STRUCTURE AND SOLAR-WIND DEPENDENCE. **Nishida, A.; Lyon, E. F. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 77: No. 22, 4086-99(1 Aug 1972).**

Explorer-35 observation of low-energy (0.1 to 3 keV) electrons in the distant geomagnetic tail at 60 R_E is analyzed and compared with the solar-wind conditions monitored simultaneously by Explorer 33. The plasma sheet extends to the lunar distance with almost the same characteristics as those observed in the near-tail region; the thickness is several Earth radii, and the flux, density, and energy are of the order of 10^9 cm^{-2} sec^{-1}, 1 cm^{-3}, and 0.6 keV, respectively. The latitudinal boundaries of the plasma sheet are essentially parallel to magnetic-field lines. Indication is seen of the thinning of the plasma sheet during polar substorms. The average energy of electrons is correlated with the solar-wind velocity in agreement with the view that plasma-sheet electrons originate from the magnetosheath. The flux is correlated with the solar-wind dynamic pressure, reflecting the dynamic balance between the solar wind and the geomagnetic tail. 23 references. (auth)

51383 IMPLICATIONS OF THE INHOMOGENEOUS PLANETARY ACCRETION HYPOTHESIS. **Anderson, Don L. (California Inst. of Tech., Pasadena). Comments Earth Sci., Geophys.; 2: No. 4, 93-8(Dec 1971).**

A model is presented in which the planets accrete from the material available to them, which in turn is a function of the minimum temperatures reached in their vicinity before the remaining material is blown away. The composition of a planet will change progressively from very refractory (Allende inclusions) to modestly refractory (eucrites) to Moon-like to Mercury-like (mesosiderites) to Earth-like to Mars-like (chondrites). Implications of this model in understanding the Earth's core are discussed. (W.D.M.)

51384 JUPITER: NEW EVIDENCE OF LONG-TERM VARIATIONS OF ITS DECIMETER FLUX DENSITY. **Klein, M. J.; Gulkis, S.; Stelzried, C. T. (Jet Propulsion Lab., Pasadena, Calif.). Astrophys. J.; 176: No. 2, L85-8(1 Sep 1972).**

Jupiter's flux density at 12.6 cm was measured at weekly intervals from May through October 1971. When compared with previous decimetric measurements, these data indicate that Jupiter's total flux density has decreased approximately 20% since 1964. No short-term variations greater than a few percent were observed. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 51457, 51462, 51524, and 52182.

51385 (AD–735514) MODELING THE D-REGION PARTIAL REFLECTION EXPERIMENT. Cohen, David Jack (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). 1 Nov 1971. Contract N00014-67-A-0385-0014. 113p. (PSU-IRL-SCI–378). NTIS.

A new volume model is developed to explain the echoes returned in the partial reflection experiment from weak D-region irregularities. This volume model is the first model that accounts for the two opposing effects of increasing electron density and added differential absorption that oppose one another within the pulse width. A previous volume model by Flood only included the effect of added differential absorption within the pulse. Computer solutions are presented for the volume model. (auth) (NTIS)

51386 (AD–735727) MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1967. Evans, John V. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). 22 Jul 1971. Contract F19628-70-C-0230. 66p. (ESD-TR–71-199). NTIS.

The results for the electron-density distribution and electron temperature of the F region obtained during 1967 using the Millstone Hill Thomson (incoherent) scatter radar system are summarized. These data, for the height interval of approximately 200 to 800 km, were gathered over 24-hour observing periods twice per calendar month. The time required to obtain a complete electron-density and temperature profile over this height interval was 30 minutes. (NTIS)

51387 (AD–736417) DESIGN AND FLIGHT OF CHARGED-PARTICLE DETECTION SYSTEMS FOR ROCKET EXPERIMENTS. Final Report, October 20, 1966–August 31, 1971. Hanser, Frederick A.; Sellers, Bach; Morel, Paul R. (Panametrics, Inc., Waltham, Mass.). Aug 1971. Contract F19628-67-C-0123. 39p. (AFCRL–71-484). NTIS.

Six auroral particle-detection systems for use on rockets were constructed, flown, and the data returned used to evaluate instrument performance. The systems consist of an electrostatic analyzer (ESA) for electrons of 1 to 10 (or 15) keV, an electron scintillator-photomultiplier combination for 10- to 200-keV electrons, and a solid-state detector for 0.3- to 3-MeV protons. One payload used a CsI(Tl) crystalphotomultiplier in place of the solid-state detector to measure 0.68- to 7.28-MeV rocket launches. The particle-detection payload proved to be quite reliable and, except for necessary modification of the ESA, should be useful for future rocket flights. (auth) (NTIS)

51388 (AD–736430) RAPID ACCESS OF SOLAR ELECTRONS TO THE POLAR CAPS. Report for July–August 1971. Turtle, John P.; Oelberman, E. J. Jr.; Blake, J. Bernard; Lancorotti, Louis J.; Vampola, Alfred L. (Aerospace Corp., El Segundo, Calif.). 15 Dec 1971. Contract F04701-71-C-0172. 23p. (SAMSO-TR–71-318). NTIS.

Simultaneous measurements of solar electrons and protons in interplanetary space and in the magnetotail were made during the onset of the Nov. 2, 1969 solar-particle event. These particle measurements, when compared with continuous trans-polar vlf measurements on three propagation paths, indicate the solar electrons have access to the magnetotail and north polar cap with a time delay t such that $0 \gtrsim t \gtrsim 1$. (auth) (NTIS)

51389 (AD–736431) UNIFIED THEORY OF SAR ARC FORMATION AT THE PLASMAPAUSE. Report for July 1970–July 1971. Cornwall, John M.; Coroniti, Ferdinand V.; Thorne, Richard M. (Aerospace Corp., El Segundo, Calif.). 15 Dec 1971. Contract F04701-71-C-0172. 50p. (SAMSO-TR–71-321). NTIS.

It is proposed that stable auroral red arcs (SAR arcs) are generated at the plasmapause as a consequence of the turbulent dissipation of ring-current energy. (NTIS)

51390 (AD–736432) STRONG PITCH-ANGLE SCATTERING OF ENERGETIC ELECTRONS IN THE PRESENCE OF ELECTROSTATIC WAVES ABOVE THE IONOSPHERIC TROUGH REGION. Report for January–June 1971. Koons, Harry C.; McPherson, Donald A.; Vampola, Alfred L. (Aerospace Corp., El Segundo, Calif.). 1 Nov 1971. Contract F04701-71-C-0172. 19p. (SAMSO-TR–71-325). NTIS.

Simultaneous measurements of energetic electrons and electrostatic waves in the midlatitude trough region indicate that events characterized by strong pitch-angle diffusion in the altitude range 2000 to 4500 km occur in the presence of elf electrostatic waves. These waves are attributed to a current-driven ion-cyclotron instability. Scattering by electrostatic waves is sufficient to account for the strong pitch-angle scattering commonly observed by low-altitude satellites. (auth) (NTIS)

51391 (AD–736759) AFCRL SCIENTIFIC RESEARCH IN GREENLAND: 1967–1970. Silverman, S. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 17 Sep 1971. 81p. (AFCRL–71-489; AFCRL-SR–123). NTIS.

The AFCRL Geopole Observatory carried out a series of measurements of geophysical interest near the north pole of the geomagnetic dipole field. The nature of these measurements, the scientific and technical background, and the status during the period 1967-1970 are described. A section presenting the data availability is also included. (auth) (NTIS)

51392 (AD–737227) EXTERNAL PRODUCTION AND CONTROL OF ELECTROJET IRREGULARITIES. Lee, Kenneth; Kaw, Predhiman K.; Kennel, Charles F. (California Univ., Los Angeles. Plasma Physics Group). Feb 1972. Contract N00014-69-A-0200-4023. 42p. (PPG–110). NTIS.

Parametric coupling of a large-amplitude "pump" wave to a natural plasma mode of the ionospheric E layer was analytically investigated. It was found that the E-layer plasma mode can be either stabilized or destabilized by the parametric process. (auth) (NTIS)

51393 (AD–737330) RELATIONSHIP BETWEEN DP-1, DP-2, THE GROWTH AND EXPANSION PHASES OF SUBSTORMS, AND IONOSPHERIC ELECTRIC FIELDS. Mozer, Forrest S. (California Univ., Berkeley. Space Sciences Lab.). 19 Jan 1972. Contract N00014-69-A-0200-1015. 11p. NTIS.

The problem of understanding the physical conditions preceding and causing the explosive or expansion phase of substorms has been studied for several years. In its most recent form this problem concerns questions of the existence of a growth phase prior to the explosive phase of a substorm and whether, if it exists, the growth phase current systems are fundamentally different from those during the expansion phase. The purpose of the present letter is to show that the resolution of different views on these questions may be achieved through examination of ionospheric electric-field data obtained during isolated substorms. (auth) (NTIS)

51394 (AD–737331) RELATIONS BETWEEN IONOSPHERIC ELECTRIC FIELDS AND ENERGETIC TRAPPED AND PRECIPITATING ELECTRONS. Mozer, Forrest S.; Bogott, Fred H.; Tsurutani, Bruce (California Univ., Berkeley. Space Sciences Lab.). 1 Feb 1972. Contract N00014-69-A-0200-1015. 27p. NTIS.

Balloon-borne electric-field and x-ray detectors have been flown from Fort Churchill and from near the foot of the magnetic-field line on which the ATS-5 satellite is located, in order to obtain and compare satellite and balloon measurements of trapped and precipitating particles with balloon measurements of the ionospheric electric field. (NTIS)

51395 (AD–737355) AN OPERATIONAL APPROACH TO FORECASTING POLAR CAP ABSORPTION (PCA) EVENTS. Krause, George J. (Weather Wing (4th), Ent AFB, Colo.). Dec 1971. 57p. NTIS.

One aspect of the Aerospace Environmental Support Center (AESC) support involves the effect of solar-proton events upon transpolar high-frequency radio propagation. This study addresses the problem of predicting the occurrence of polar-cap absorption (PCA) events resulting from solar-proton enhancements near Earth. Various aspects of the energetic solar-flare event are reviewed, and an attempt is made to assess their relative importance in arriving at a PCA forecast. Data pertinent to the flare event are considered in five general classes: radio burst data, x-ray burst data, optical data, solar region history, and the sector structure of the interplanetary magnetic field. An evaluation checklist is developed for use by the AESC forecaster. The checklist reflects the varying degrees of contributions of information in the five categories toward determining the "Total PCA Factor." (auth) (NTIS)

51396 (AD–737544) OBSERVATIONS OF SAR ARCS FROM THE OV1-10 SATELLITE. Report for December 1966–March 1967. LaValle, Samuel R.; Elliott, David D. (Aerospace Corp., El Segundo, Calif.). 15 Dec 1971. Contract F04701-71-C-0172. 35p. (SAMSO-TR–72-38). NTIS.

Three mid-latitude red arcs were measured by the night airglow photometer on board the OV1-10 (1966-111B) satellite during the winter of 1966-1967. One arc was observed as a conjugate phenomenon. Another arc was observed for two days at a constant local time and was found to decrease in intensity, increase in width, and move to higher L values with universal time. Both of these arcs were found to be associated with the plasmapause, the location of which was determined from the vlf measurements made from the OV3-3 (1966-70A) satellite. These observations are shown to be consistent with the theory that SAR arcs are generated at the plasmapause as a consequence of the turbulent dissipation of ring-current energy. (NTIS)

51397 (AD–737790) IONOSPHERIC RESEARCH USING SATELLITES: EQUATORIAL SCINTILLATION. Report for March 1–December 31, 1970. Koster, John R. (Ghana Univ., Legon. Dept. of Physics). Sep 1971. Contract F61052-70-C-0004. 84p. (AFCRL–71-609). NTIS.

A summary of previous work on ionospheric scintillation done at Legon, Accra, Ghana is presented. It gives smoothed curves showing the seasonal variation of scintillation for the parts of 4 successive years (1967-70) for which records were obtained. It is shown that nights of much reduced scintillation are also nights of unusually high values of Faraday rotation angle. It is shown that there is a statistically significant reduction of scintillation on nights of magnetic disturbance characterized by a high value of the K(p) index. It compares scintillation data from Legon, Ghana and Huancayo Peru, over a six-month period, and briefly reviews present knowledge of the convective motion of field lines in the magnetosphere, and shows that equatorial scintillation is closely associated with that motion. (auth) (NTIS)

51398 (AD–738651) EXCITATION OF O_2 IN AURORAS. Report for February–November 1971. Cartwright, David C.; Trajmar, Sandor; Williams, Walter (Aerospace Corp., El Segundo, Calif.). 1 Mar 1972. Contract F04701-71-C-0172. 23p. (SAMSO-TR–72-50). NTIS.

Very intense emission of 1.27-μ radiation was detected from auroras in both aircraft and rocket experiments, the magnitude of which greatly exceeded that predicted by using the previously available electron-impact excitation cross sections. These new excitation cross sections, along with the measured secondary electron spectrum and recently reported quenching rates, are used to determine what fraction of the measured oxygen emissions can be attributed to direct electron impact excitation, and their volume emission rates relative to that for 3914 A. (NTIS)

51399 (AD–738652) IR EMISSION SPECTRUM OF N_2-EXCITED AURORAL CONDITIONS. Report for February–November 1971. Cartwright, David C.; Williams, Walter; Trajmar, sandor (Aerospace Corp., El Segundo, Calif.). 1 Mar 1972. Contract F04701-71-C-0172. 20p. (SAMSO-TR–72-51). NTIS.

Recently determined experimental and theoretical cross sections for electron impact excitation of six triplet states of N_2(A, B, W, C, E, D) were utilized to predict the absolute ir volume emission rates from N_2 under nighttime auroral conditions. Secondary electron fluxes appropriate to an IBC-II normal aurora were used in the calculations. The cascade contributions coupling the various electronic states were included as well as the most important quenching processes. The results indicate that the B to A, A to B and W to B, B to W cascade processes, which are important in the population of the A, B, and W states, produce appreciable radiation in the 1- to 5-μ wavelength region. (auth) (NTIS)

51400 (AD–739887) COMPARISON OF ELECTRON FLUXES WITH THE WHISTLER SELF-EXCITATION LIMIT DURING A MAGNETIC STORM. Environmental Research Papers. Rothwell, Paul L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 21 Jan 1972. 15p. (AFCRL–72-86; AFCRL-ERP–386). NTIS.

The measurements from a magnetic spectrometer flown on board Air Force satellite OV1-13 during the magnetic storm of June 9, 1968 show that a large number of 115- and 180-keV electrons were injected into the outer radiation belt and remained there throughout the storm period. It is shown that these fluxes are consistent with an equatorial energy spectrum in which 40-keV electrons were at their whistler self-excitation limit. It is suggested that the whistlers played a role in the observed enhancement of MeV electrons off the equator. (auth) (NTIS)

51401 (AD–739920) MEASURING 557.7-NM AIRGLOW CHANGES ASSOCIATED WITH UPPER ATMOSPHERIC ION CLOUD RELEASES. Ozolins, Aivars (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Mar 1972. 16p. (BRL-MR–2156). NTIS.

Ground-based airglow measurements at 557.7 nm were conducted during the SECEDE-II barium cloud releases to gather information on a proposed coupling between the ion clouds and the E-layer through charge transport. The twilight background signal at release time was found to be too large for measuring the small effect with the available equipment. After the tests the field data were used in an instrument performance study. The results of this study will be useful in designing equipment for future measurements of this type. (auth) (NTIS)

51402 (AD–739930) RESEARCH DIRECTED TOWARD THE DESIGN, DEVELOPMENT, CONSTRUCTION AND INSTALLATION OF INSTRUMENTATION TO STUDY ENERGY SPECTRA OF HIGH-ENERGY SOLAR PROTONS IN POLAR CAP EVENTS. THE ARCAS PROTON PAYLOAD. Sellers, Bach; Hunerwadel, Jean Luc; Hanser, Frederick A. (Panametrics, Inc., Waltham, Mass.). Jan 1972. Contract F19628-71-C-0086. 34p. (AFCRL–72-5). NTIS.

A payload for measurement of 7- to 150-MeV protons and 30- to 1000-MeV alpha particles was designed, integrated into, and flown successfully on an Arcas rocket into a solar particle event at Thule on March 29, 1970. The T. M. system has only one channel (IRIG E). Data are transmitted and recorded on magnetic tape for each coincidence occurring in a two-detector semiconductor telescope. Subsequently, these data are analyzed to determine the relative energy distributions, the angular distribution, the intensity of the energy distribution and the particle types. (auth) (NTIS)

51403 (AD–740099) EARTH ALBEDO NEUTRONS FROM 10 TO 100 MeV. Preszler, Alan M.; Simnett, George M.; White, R. Stephen (California Univ., Riverside. Inst. of Geophysics and Planetary Physics). 1 Feb 1972. Contract N00014-69-A-0200-5001. 19p. (IGPP-UCR–72-1). NTIS.

The measurement of the energy and angular distributions of earth albedo neutrons from 10 to 100 MeV is reported. The measurements were made at 40°N geomagnetic latitude from a balloon at 120,000 ft (below 4.65 g/cm^2 of the residual atmosphere). The fluxes of upward moving neutrons at angles of 20 to 70° to the vertical show that the lower-energy neutrons are peaked near the vertical. The distributions are integrated over angle to give an omnidirectional energy distribution for upward-moving neutrons that is flat to 50 MeV then decreases with energy. The absolute neutron flux is of the correct strength and the energy distributions of the correct shape for the albedo neutrons to be the source of the protons trapped in the Earth's inner radiation belt. (auth) (NTIS)

51404 (ESRO-SP–60, pp 153-4) OGO-5 LYMAN-ALPHA OBSERVATION OF AURORAL PRECIPITATION. Berteaux, J. L. (CNRS, Verrieres-le-Buisson, France).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Results from OGO-5 measurements of the intensity and width of the Lyman-alpha line scattered by the hydrogen geocorona are discussed, and similar experiments on solar-proton interactions are proposed. (France)

51405 (ESRO-SP–72, pp 43-62) RECENT WORK ON ION-CYCLOTRON WHISTLERS. Jones, Dyfrig (European Space Research and Tech. Centre, Noordwijk, Holland).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

A considerable amount of experimental and associated theoretical research has recently been concentrated on the mechanisms that affect electromagnetic waves propagating in the upper ionosphere at frequencies in the region of the local ion gyrofrequencies. It is found that both polarization reversal and mode coupling manifest themselves in the phenomena observed in this vlp range by satellite receivers. In addition, reflection of the ion cyclotron mode at an altitude that is dependent on frequency is also important in the case of waves propagating downwards into the ionosphere from above. On investigating these effects in detail, interesting new phenomena can be postulated on theoretical grounds. (auth)

51406 (ESRO-SP–72, pp 95–107) WAVES GENERATED BY A CONTROLLED BEAM OF ELECTRONS ARTIFICIALLY INJECTED INTO THE IONOSPHERE: THE ELECTRON ECHO EXPERIMENT. Cartwright, D. G.; Kellogg, P. J. (Univ. of Minnesota, Minneapolis).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The Electron Echo Experiment injected about 3000 pulses of energetic electrons into the ionosphere at pitch angles between 65° (down the field) and 115° (up the field) from an Aerobee 350 sounding rocket launched from the Wallops Island Firing Range, Va. The pulses were 16 ms long, spaced $\frac{1}{10}$ s apart; the beam current was 70 mA, and the electron energy varied between 35 and 45 keV. The observations in the frequency range 16 Hz to 10 MHz of the electric component of waves generated by the experiment are presented. Wave generation by the beam electrons was observed at frequencies near the plasma frequency and the upper hybrid resonance frequency of the ambient ionospheric electrons, at frequencies below the electron cyclotron frequency (whistler mode) and at frequencies near twice the electron cyclotron frequency (possibly Bernstein mode). Also a 200 mA beam of argon ions of 50 eV energy generated waves near the lower hybrid resonance frequency. All of these waves have phase velocities low enough to interact strongly with the emitting particles; to within an order of magnitude the observed amplitude of all except the Bernstein-mode waves can be accounted for by Cherenkov-like emission from the energetic particles. However, the variation of the observed amplitudes with injection pitch-angle and with time from the beginning of the pulse show peculiarities which are not yet understood. (auth)

51407 (ESRO-SP–72, pp 109-21) STUDIES OF VLF EMISSIONS IN THE SATELLITE ARIEL 3. Kaiser, T. R. (Univ. of Sheffield, Eng.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Ariel 3 was a near-Earth satellite (altitude 500 to 600 km) with a high-inclination orbit. Tape-recorder storage provided almost continuous data over a period of 10 months at all magnetic latitudes and local times. vlf emissions were observed primarily in two regions at high invariant latitudes (70 to 80° LAMBDA) and at medium latitudes (50 to 60° lambda). Medium-latitude emissions are generated close to the equatorial plane by the transverse resonance instability and have a strong storm-time dependence. They also exhibit a marked longitudinal structure that co-rotates with the Earth. High-latitude emissions are an auroral-oval type of phenomenon, with pronounced maxima at 23 and 14 h MLT. These are attributed, respectively, to precipitation of soft electrons from the magnetospheric tail and from the cusps on the solar side. (auth)

51408 (ESRO-SP–72, pp 123-33) EXPERIMENTAL STUDY OF ELECTRON PITCH-ANGLE DIFFUSION IN THE PRESENCE OF VLF MODULATED HISS. Etcheto, J.; Gendrin, R.; Lemaire, D. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Results obtained during a rocket experiment (Kerguelen Islands, March–April 1968) in which particles and vlf waves were measured simultaneously are presented. vlf modulated hiss was present during the flight. The electron precipitation was observed to increase at the same time as the amplitude of the vlf waves. Assuming a gyroresonant interaction to be the cause of this phenomenon, the region of resonance has been located. It is found to be wide in latitude. The distribution function of the electrons in the vicinity of the loss cone was measured partially. The anisotropy was observed to decrease when the vlf field increased, so increasing the pitch-angle diffusion, and to increase when the field decreased. From this measurement of the anisotropy values for the diffusion coefficient at the maxima and minima of the modulation were deduced. The values obtained in this way are consistent with those obtained independently from the amplitude of the vlf waves. At the same time a ulf wave was present, with approximately the same periodicity as the vlf hiss modulation. The case is one of succession of weak and near-strong diffusions. The ratio of the flux at the maxima and minima of diffusion is of the order of 2, as predicted by theory. (auth)

51409 (ESRO-SP–72, pp 139-44) CORRELATION BETWEEN VLF EMISSION FLUX AND ELECTRON-PITCH ANGLE DISTRIBUTION AS DEDUCED FROM A ROCKET FLIGHT IN THE AURORAL ZONE. Hamelin, M. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Preliminary results from a rocket experiment launched in the auroral zone with a vlf receiver and energetic electron detectors on board are presented. These detectors were set roughly in the direction of the spin axis and the perpendicular to this axis. The energy detected was divided into several channels between 10 and 300 keV. A vlf emission, auroral chorus, was detected between 400 and 1000 Hz during two separate periods. The data show a strong enhancement of precipitated and trapped electron fluxes occurring during the chorus events; the correlation seems to be best in the 50 to 170 keV energy channels. These events are associated with an increase in the amplitude of the Pc3–4 magnetic disturbances detected on the ground. (auth)

51410 (ESRO-SP–72, pp 147-56) PROBLEMS RELATED TO HIGH-LATITUDE ELECTRIC FIELDS AND CURRENTS. Faelthammar, C. G.; Block, L. P. (Kungliga Tekniska Hogskolan, Stockholm).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Various experiments and coordinated studies that may help to clarify the complicated electrodynamics of the low-density plasma above the ionosphere are proposed. (France)

51411 (ESRO-SP–72, pp 187-95) WAVE AND BEAM LABORATORY EXPERIMENTS IN A MAGNETO-ACTIVE PLASMA. Christiansen, P. J.; Christopoulos, C.; Martelli, G. (Univ. of Sussex, Brighton, Eng.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Experiments are described that examine: the nonlinear interaction of fast electron beams with whistler (helicon waves) at the Doppler shifted cyclotron frequency, the results being compared with some theoretical predictions; the natural noise spectra near the electron cyclotron frequency of an rf excited plasma; the propagation of Bernstein waves at ambient plasma densities one order of magnitude higher than hitherto employed by other authors. (auth)

51412 (ESRO-SP–72, pp 197-208) PARALLEL ELECTRIC FIELD NEAR THE AURORAL IONOSPHERE DEDUCED FROM ENERGY SPECTRA, ANGULAR DISTRIBUTIONS, AND TIME VARIATIONS OF LOW-ENERGY AURORAL ELECTRONS AND PROTONS. Reme, H.; Bosqued, J. M. (Univ., Toulouse).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

A correlation (during 115 seconds) was observed between 5- to 30-keV electron flux variations and small pitch-angle (0.5 to 5 keV) proton flux variations in a French Dragon rocket experiment fired into the diffuse aurora from Andenes, Norway at about 0428 geomagnetic LT on November 3, 1968. All the features of the particles (energy spectra, angular distributions, time variations) can be interpreted in terms of the presence (during 115 seconds) along the geomagnetic-field lines of a 1 to 2 kV potential difference situated below an altitude of 1500 km accelerating positively charged particles. The origin of this parallel electric field, which was recently theoretically predicted by Kindel and Kennel, is not entirely understood. The source of the electric field is plasma turbulence linked with 5 to 30 keV electron precipitation, which causes an increase in the parallel resistance due to ion cyclotron waves. (auth)

51413 (ESRO-SP–72, pp 231-9) PHYSICS OF THE CHANNEL ELECTRON MULTIPLIER. Barat, C. (Univ., Toulouse).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Since 1966, the Center for Study of Radiations in Space has been using windowless tubular electron multipliers for the detection of low-energy charged particles in rocket and satellite experiments. The principal characteristics and the working conditions of this detector are given. The stability of these characteristics under the conditions of the space environment, and the latest results obtained from a study of the aging of the tube are discussed. (auth)

51414 (LA-DC–72-746) PARAMETRIC INSTABILITIES OF VLF WAVES. Forslund, D. W.; Kindel, J. M.; Lindman, E. L. (Los Alamos Scientific Lab., N. Mex.). [nd]. 6p. (CONF-720644–1). Dep. NTIS.

From Sub-LF downlink satellite communications conference; Washington, D. C. (6 Jun 1972).

Instabilities of whistler waves in the radiation belts are discussed. An analysis of the dispersion relations reveal certain parametric instabilities. Some nonlinear results of computer calculations are described. (M.O.W.)

51415 (TRITA-EPP–72-7) POTENTIAL DOUBLE LAYERS IN THE IONOSPHERE. Block, Lars P. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Apr 1972. 53p. Dep. NTIS (U. S. Sales Only).

Langmuir's old theory of double layers is reviewed and extended to ionospheric conditions, including effects of gravity and expansion in diverging geomagnetic flux tubes. Bohm's self-consistency condition is refined by including the temperature of the beam particles. Chances for stable sheaths are greatest at 1000- to 3000-km altitude on closed field lines, or higher on open plasma sheet field lines, and near the F-region maximum for upward currents, according to observations. Randomly arising and disappearing double layers may cause anomalous resistivity in regions where the plasma is subject to rarefaction instabilities, namely in the polar wind for upward currents, below the F-region maximum for downward currents, and in the topside ionosphere in a limited region at perhaps 1000- to 5000-km altitude. When double layers occur plasma is accelerated upwards, and the topside electron density may be reduced considerably within minutes. At the same time the electric fields in the double layers accelerate large fluxes of particles, both downwards as precipitation, and upwards as energetic particles, preferably observed in the midnight sector, e.g. at synchronous altitude. However, in spite of the very large fluxes there is no particle depletion problem, since current systems are always closed. Electrostatic parallel electric fields can also be constructed, such that both electrons and protons precipitate at the same place. (auth) (Sweden)

51416 DIRECT MEASUREMENTS OF PLASMA DRIFT VELOCITIES AT HIGH MAGNETIC LATITUDES. Doupnik, Joe R. (Univ. of California, San Diego, La Jolla); Banks, Peter M.; Baron, Murray J.; Rino, Charles L.; Petriceks, Juris. J. Geophys. Res.; 77: No. 22, 4268-71(1 Aug 1972).

The ionospheric plasma transport velocity was measured over a 24-hr period in the auroral zone with an incoherent-scatter radar. The parameters measured by the radar in Chatanika, Alaska, are the electron density, electron and ion temperatures, and the plasma transport velocity along the line of sight of the narrow 0.6° beam of the steerable antenna. Data were obtained from 90 to 500 km. The F-region transport at this site is closely associated with magnetospheric convection, particularly at night, and the radar can provide data on the behavior of the magnetosphere. (J.C.W.)

51417 ANOMALOUS INCREASE IN THE TOTAL X-RAY BACKGROUND AT BALLOON ALTITUDE. Manchanda, R. K. (Tata Inst. of Fundamental Research, Bombay). J. Geophys. Res.; 77: No. 22, 4254-8(1 Aug 1972).

An anomalous behavior in the total counting rate of an x-ray detector was observed at ceiling altitude in a balloon flight made from Hyderabad, India (geographic latitude and longitude of 17°N and 78.5°E and geomagnetic latitude of 8°N), on April 16, 1969. In an instrument designed to study cosmic x rays below 150 keV, the counting rates in the channels of 13 to 50 keV showed an unexpected increase by a factor of about 2 at a ceiling altitude of 4.5 g/cm^2, whereas the in-flight calibration and the two-fold coincidence monitoring showed the perfect behavior of the detector. The counting rates became normal after ~1 hr. The detailed analysis indicates that the increase was more pronounced in the lower-energy region of 13 to 25 keV than in the region of 25 to 50 keV, whereas the duration of the increase was longer at the higher-energy interval. (auth)

51418 ALIGNMENT OF AURORAL ARCS. Akasofu, S.-I.; Kimball, D. S. (Univ. of Alaska, Fairbanks). J. Geophys. Res.; 77: No. 22, 4233-6(1 Aug 1972).

The results are summarized of a study of the alignment of auroral arcs from all-sky photographs taken during 20 aircraft flights in the northern polar region in 1969, 1970, and 1971. The oval distribution pattern of visible auroral arcs is clearly delineated by the observation. The results are in many respects in agreement with a recent study of the southern oval by Bond and Thomas (1971). (auth)

51419 NEW METHOD FOR IN SITU ELECTRON TEMPERATURE DETERMINATIONS FROM PLASMA WAVE PHENOMENA. Oya, Hiroshi; Benson, Robert F. J. Geophys. Res.; 77: No. 22, 4272-6(1 Aug 1972).

Discrepancies have been reported between the values of the electron temperature deduced from satellite electrostatic-probe measurements and those deduced from ground-based radar backscatter measurements. The discrepancy (the radar backscatter temperature is lower than the probe temperature) is not present when the probe experiment is flown on a rocket to lower altitudes, but it reappears when the rocket probe attains higher altitudes. A new method of determining the electron temperature from the satellite resonant phenomena is presented here. It is based on the splitting (observed at high latitudes) of the diffuse resonance that occurs at the frequency f_{D1} between f_H and $2f_H$ as determined by Oya, 1970 (NSA 24:45100). The new in situ method eliminates the extensive calculations necessary in other methods. (J.C.W.)

51420 DIURNAL VARIATION OF THE H^+ FLUX BETWEEN THE IONOSPHERE AND THE PLASMASPHERE. Nagy, A. F. (Univ. of Michigan, Ann Arbor); Banks, P. M. J. Geophys. Res.; 77: No. 22, 4277-9(1 Aug 1972).

The results of calculations carried out to evaluate a quiet-day diurnal variation of the H^+ flux between the ionosphere and the protonosphere are given. The variation of the calculated H^+ flux and density at 4500 km along the field line and the measured O^+ density at 500 km at Millstone Hill for Mar. 23–24, 1970 are shown. The same quantities are shown for Dec. 7–8, 1965 at Arecibo. The Arecibo L value is 1.48; therefore the corresponding protonospheric field tube is never depleted; but the plasmapause does move by the Millstone Hill field tube (L = 3.2) during intense magnetic storms. The Millstone Hill data used in these calculations correspond to a quiet magnetic period preceded by more than 10 days of low magnetic activity (Ap < 10); the Arecibo results also correspond to magnetically quiet conditions corresponding to two field tubes of significantly different size. (J.C.W.)

51421 AURORAL EMISSIONS AND PARTICLE PRECIPITATION IN THE NOON SECTOR. Heikkila, W. J. (Univ. of Texas, Dallas); Winningham, J. D.; Eather, R. H.; Akasofu, S.-I. J. Geophys. Res.; 77: No. 22, 4100-15(1 Aug 1972).

Air-borne optical measurements during December 1969 are compared with satellite particle measurements made earlier in 1969. The latitudinal distributions of $H\beta$, λ4278, and λ6300 emissions during quiet periods are observed to agree with what would be expected from the latitudinal distribution of particle precipitation during similar conditions. In particular, there is a belt 200 to 500 km wide (at ionospheric heights) in which the magnetosheath plasma penetrates down to low altitudes through the cusps in the dayside magnetosphere and in which both $H\beta$ and λ6300 emissions are observed. There are brighter red arcs with green lower borders within this belt. It is suggested that these are produced by narrow regions of precipitation of slightly more energetic electrons embedded in the cusp fluxes. Poleward of this belt the flux of particles is low, and the atmospheric emissions are very weak, except for occasional narrow regions of electron precipitation (without measurable protons) and the corresponding polar-cap aurora (without the $H\beta$ emission). In the morning sector a wide region of precipitating outer Van Allen belt electrons is observed equatorward of the cusp. A corresponding diffuse glow of λ5577 and λ4278 emissions is observed. These features are also present in the afternoon but are much weaker in intensity. Data supporting these conclusions are presented, including color all-sky photographs and photometric latitude profiles obtained from high-altitude aircraft and intensity-modulated energy-time spectrograms for particle fluxes. (37 references) (auth)

51422 LOCAL-TIME SURVEY OF PLASMA AT LOW ALTITUDES OVER THE AURORAL ZONES. Frank, L. A.; Ackerson, K. L. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 77: No. 22, 4116-27(1 Aug 1972).

A local-time survey of the low-energy proton and electron intensities precipitated into the earth's atmosphere over the auroral zones during periods of magnetic quiescence was made by selecting a typical individual satellite crossing of this region in each of eight local-time sectors from a large library of similar observations with the polar-orbiting satellite Injun 5. The trapping boundary for more-energetic electron intensities, E > 45 keV, was found to be a natural coordinate for delineating the boundary between the two major types of lower-energy, $50 \leq E \leq 15{,}000$ eV, electron precipitation commonly observed over the auroral zones at low altitudes. Poleward of this trapping boundary inverted V electron precipitation bands are observed in all local-time sectors. These inverted V electron bands in the evening and midnight sectors are typically more energetic and have greater latitudinal widths than their counterparts in the noon and morning sectors. Equatorward of the trapping boundary the electron energy influx is dominated by plasma-sheet electron intensities in the midnight and early-morning sectors. Precipitation of ring-current proton intensities is most often observed in the late-evening sector and equatorward of the major regions of electron influx. In general the main contributors to the electron energy influx into the Earth's atmosphere over the auroral zones are the electron inverted V precipitation poleward of the trapping boundary in late evening, the plasma-sheet electron intensities equatorward of this boundary in early morning, and both of these precipitation events near local midnight. These observations of low-altitude charged-particle intensities are interpreted favorably in terms of a current magnetospheric model and in comparison with similar measurements in the distant magnetosphere. (18 references) (auth)

51423 EVALUATION OF THE INTENSITY OF CHERENKOV RADIATION FROM AURORAL ELECTRONS WITH ENERGIES DOWN TO 100 eV. Lim, T. L.; Laaspere, Thomas (Dartmouth Coll., Hanover, N. H.). J. Geophys. Res.; 77: No. 22, 4145-57 (1 Aug 1972).

The intensity of incoherent Cherenkov radiation in the dayside polar-cusp region was estimated by including the very soft (100 eV to 1 keV) energy range, which recent experimental results have shown to be the source of broad-band auroral hiss at least on the dayside of the Earth. Results show that, for an electron flux spectrum of the approximate form $dJ/dE \propto E^{-2}$, electrons in the range 100 eV to 1 keV contribute about 2 orders of magnitude more to the intensity of Cherenkov hiss than those in the range 1 to 10 keV. If the electron flux is assumed to have the value of 5×10^5 el cm^{-2} sec^{-1} $ster^{-1}$ ev^{-1} at 700 eV, a peak Cherenkov hiss intensity of $\simeq 10^{-13}$ w m^{-2} Hz^{-1} results at ionospheric heights at $\simeq$70 kHz and decreases in intensity toward both lower and higher frequencies. A limitation of the present theories is pointed out, and the possible role of anomalous cyclotron radiation in the auroral hiss generation is discussed. It is concluded that, even if the generation mechanism is not totally incoherent, as has been assumed in the calculations, it almost certainly involves electrons that are moving faster than the wave. If the calculations are repeated at a lower latitude, appropriate to the nightside auroral hiss zone, essentially identical results are obtained if the dayside model ionosphere and the dayside electron flux spectrum are used. These results indicate that, if incoherent Cherenkov radiation is the source of auroral hiss, the generally weaker hiss on the nightside of the Earth must be due to lower electron fluxes, harder spectra, lower magnetospheric electron densities, or a combination of these factors. (24 references) (auth)

51424 SATELLITE SURVEY OF VECTOR ELECTRIC FIELDS IN THEIONOSPHERE AT FREQUENCIES OF 10 TO 500 Hz. I. ISOTROPIC, HIGH-LATITUDE ELECTROSTATIC EMISSIONS. Kelley, M. C.; Mozer, F. S. (Univ. of California, Berkeley). J. Geophys. Res.; 77: No. 22, 4158-73(1 Aug 1972).

Vector electric fields in the frequency range from 10 to 500 Hz were measured on the 400-km altitude polar orbiting OV1-17 satellite. The detector had a broad-band threshold level measured in flight to be 20 μV/m; it was more sensitive to ionospheric electromagnetic waves below 80 Hz than presently available search coil magnetometers and was free from in-orbit interference. Two distinct fluctuation modes have been observed on every orbit to be characteristic of the ionosphere at 400 km. The first of these modes, discussed in detail, has an electric-field vector in the satellite frame of reference that is isotropic, that has a power law spectrum with an exponent of -0.73 ± 0.1, and that has a peak intensity at 12 Hz as great as 1 mV/m Hz$^{1/2}$. This mode is observed throughout the high-latitude region between two sharp boundaries located at about 55° invariant latitude on the nightside and 75° on the dayside. The observed boundary for low-frequency electric field fluctuations is thus not coincident with the auroral oval at all local times, as had been reported earlier. These properties and additional information on the wavelength spectrum of the fluctuations are consistent with interpretation as electrostatic disturbances whose spatial variations along the trajectory were measured. The observation of strong electric-field fluctuations parallel to the Earth's magnetic field B_0 implies that ionospheric plasma physics cannot be described by first-order magnetohydrodynamic theory in which the parallel electric field is identically equal to zero. If the fluctuations are due to waves, then under certain assumptions on the wave frequency, the signal is intense enough to cause wave-particle interactions which reduce the plasma conductivity parallel to B_0 sufficiently to support parallel dc electric fields of the order of 10 mV/m. The region of occurrence of the turbulent electric field is in good agreement with that of ionospheric plasma turbulence as deduced from the scintillations of radio stars and measurements of spread F. (41 references). (auth)

51425 SATELLITE SURVEY OF VECTOR ELECTRIC FIELDS IN THE IONOSPHERE AT FREQUENCIES OF 10 TO 500 Hz. II. THE ELECTRIC COMPONENT OF ELF HISS. Kelley, M. C.; Mozer, F. S. (Univ. of California, Berkeley). J. Geophys. Res.; 77: No. 22, 4174-82(1 Aug 1972).

The wave electric-field experiment on the 400-km polar orbiting OV1-17 satellite observed two modes that are present in characteristic regions of every orbit in the measured frequency range of 12 to 500 Hz. One of these modes, described here, is observed on closed magnetic-field lines in the noon–midnight meridional plane. This mode has a spectrum that increases rapidly with frequency over the measured frequency range; a wave electric-field vector that is confined to and isotropic in the plane perpendicular to the local magnetic field direction; a phase velocity in excess of 35 km/sec; and a typical signal amplitude at 500 Hz of 5 μV/m Hz$^{1/2}$. These properties suggest that the wave mode is not electrostatic. From the agreement of the amplitude, spectrum, and region of occurrence of the electric-field data with earlier magnetic measurements, it is concluded that the signals are due to the electric component of an electromagnetic wave and that the observed emission is elf hiss. A sharp transition between this emission and the low-frequency fluctuations described in the first paper of this series occurs on the dayside. Between 0600 and 1300 magnetic local time (MLT) this transition occurs near the invariant latitude of the auroral oval, whereas in the afternoon the boundary is at a lower latitude. (auth)

51426 SATELLITE SURVEY OF VECTOR ELECTRIC FIELDS IN THE IONOSPHERE AT FREQUENCIES OF 10 TO 500 Hz. III. LOW-FREQUENCY EQUATORIAL EMISSIONS AND THEIR RELATIONSHIP TO IONOSPHERIC TURBULENCE. Kelley, M. C.; Mozer, F. S. (Univ. of California, Berkeley). J. Geophys. Res.; 77: No. 22, 4183-9(1 Aug 1972).

Occasional observations of intense low-frequency electric-field fluctuations were made near the magnetic equator by the vector ac electric-field experiment performed on the OV1-17 satellite, which was in a circular polar orbit at an altitude of about 400 km. The observed fluctuations are correlated with spread F at an equatorial ground station located near the projection of the vehicle trajectory onto the surface of the Earth. This correlation suggests that the ionospheric electric-field turbulence is related to the modification of the propagation of radio waves and that this relationship results in scattering of the radio signals from irregularities of the medium. The polarization, intensity, and spectral characteristics of the signal are similar to the high-latitude low-frequency electric fields that were detected on every orbit of OV1-17 and that were described in paper 1 of this series. This similarity suggests that the instability responsible for the turbulence is the same in two regions. 7 references. (auth)

51427 REMARKS ON THE OH ROTATIONAL TEMPERATURE IN THE NIGHT GLOW. Shefov, N. N. (Inst. of Physics of the Atmosphere, Moscow). Can. J. Phys.; 50: No. 11, 1225-6 (1 Jun 1972).

Attention is drawn to a discrepancy between the population distributions of the OH rotational levels (K′ are 1 to 5) obtainable from the night-glow spectra recorded with the spectral resolutions of 2 to 5 Å and 27 Å. (auth) (Canada)

51428 MODIFYING THE IONOSPHERE WITH RADIO WAVES. Utlaut, W. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). New Sci.; 55: No. 808, 288-90(10 Aug 1972).

Recent experiments with high-power radio waves have proved the feasibility of altering the ionosphere's properties in a temporary fashion. They offer a new means of studying the upper atmosphere and have already produced some unexpected effects. The technique also has relevance to plasma physics. (auth)

51429 STABLE AURORAL RED ARCS. Cole, K. D. (La Trobe Univ., Bundoora, Australia); Jacka, F.; Thomas, J. A. Aust. Phys.; 9: No. 6, 87-90(Jun 1972).

Current knowledge of SAR arcs is reviewed with particular reference to Australian studies. The theory of decay of the magnetospheric ring current is outlined and some experiments made in an attempt to verify predictions from it are briefly described. (Australia)

51430 MEASUREMENTS OF MeV ELECTRONS DURING THE RECOVERY PHASE OF A POLAR MAGNETIC SUBSTORM ON MARCH 6, 1970. Boehm, Juergen (Univ., Kiel). Z. Geophys.; 38: No. 2, 291-317(Jul 1972).

In connection with the SPAZ rocket program electrons with energies E of 2.5 to 3.5 MeV have been measured on March 6, 1970, during a rocket flight from Andenes (Norway) in heights between 80 and 217 km. The rocket was launched into the recovery phase of a magnetic substorm. The measured integral electron spectrum averaged over the flight was $I(>E) \cong 1.1 \cdot 10^6 \exp(-E/0.22)$ e/(cm^2 sec ster), E in MeV. The strong riometer absorption measured at the launching site was accompanied by scarcely any variation of the horizontal component of the magnetic field. It can be concluded by a comprehensive analysis of this ionospheric substorm by means of magnetometer and riometer measurements, satellite measurements of electrons and protons in the outer radiation belt, and interplanetary magnetic-field measurements that the MeV-electron precipitation of this ionospheric substorm was caused by an expansion of the Earth's magnetic field, correlated with a turn of the interplanetary magnetic field to the north. The appearance of similar ionospheric substorms in the recovery phase of other polar magnetic substorms suggests a fundamental importance of this process. (auth)

51431 ALTITUDE PROFILE OF $O_2(^1\Delta_g)$ AT NIGHT. Bishop, R. H.; Baker, K. D.; Han, R. Y. (Utah State Univ., Logan). J. Atmos. Terrest. Phys.; 34: No. 9, 1477-82(Sep 1972).

The altitude profile of the infrared atmospheric system of oxygen $(a^1\Delta_g - X^3\Sigma_g^-)$ was measured at night on two separate occasions. The measurements were made at 1.27 μ by single-channel radiometers flown as part of rocket payloads. Both rockets were launched at Ft. Churchill, Canada, during disturbed conditions, one in March 1969 and the other in November 1969. Both measurements indicated a maximum concentration of molecules in the $O_2(^1\Delta_g)$ state of about 2×10^8 cm^{-3} near 90 km. The total equivalent vertically integrated emission intensity of about 180 kR on both flights appears to indicate the possibility of some auroral enhancement. Implications of these results are discussed. (auth)

51432 ELECTRON AND POSITIVE ION DENSITY ALTITUDE DISTRIBUTIONS IN THE EQUATORIAL D-REGION. Aikin, A. C.; Goldberg, R. A.; Somayajulu, Y. V.; Avadhanulu, M. B. (Goddard Space Flight Center, Greenbelt, Md.). J. Atmos. Terrest. Phys.; 34: No. 9, 1483-94(Sep 1972).

Simultaneous measurements of D-region ionization sources and electron and ion densities were made in one day aboard three rockets. Electron-density profiles for solar zenith angles of 53.2, 27.8 and 48.3° are displayed. The profiles are found to be quite similar to those reported for midlatitudes under non-winter quiet conditions. Simultaneous measurement of the x-ray flux together with NO ionization estimates based on recent measurements of NO by Meira (1971) and $O_2(^1\Delta_g)$ ionization rates by Huffman et al. (1971) are used to compute the ion-pair production rate. It is demonstrated that the charged-particle distribution can be explained using this production rate and an effective recombination coefficient compatible with recent laboratory measurements of the dissociative recombination coefficient for electrons with hydrated cluster ions. (auth)

51433 ATMOSPHERIC EFFECTS ON THE SURFACE COSMIC RAY MESON INTENSITY RECORDED IN LONDON. Hashim, A.; Speller, R. D.; Thambyahpillai, T. (Imperial Coll. of Science and Tech., London). J. Atmos. Terrest. Phys.; 34: No. 9, 1525-35(Sep 1972).

Cubical meson telescopes without any lead filter and tilted at 45° to the vertical were operated in London from July 1965 onwards. The first 2 years' data were subject to correlation analysis in order to study the atmospheric effects on the cosmic-ray intensity. The analysis involved a division of the atmosphere into three layers for a study of temperature effects as well as the regression equations used by Duperier (1949, 1951) and Mathews (1959). The temperature coefficients obtained by the multiple layer method agree with Dorman's (1957) calculations in the upper and middle regions of the atmosphere but are systematically lower than the theoretical value in the lower atmosphere. This reduction was attributed to the presence of the electron component whose positive temperature effect can offset the negative temperature effect of the muons. In an intercomparison of the various correction schemes it is found that the multiple-layer method gives the highest multiple correlation coefficient and, when the data are corrected for atmospheric effects, the smallest residual variations. (auth)

51434 SKYLIGHT INTENSITY, POLARIZATION, AND AIRGLOW MEASUREMENTS DURING THE TOTAL SOLAR ECLIPSE OF 30 May 1965. Miller, R. E.; Fastie, W. G. (Xavier Univ., Cincinnati). J. Atmos. Terrest. Phys.; 34: No. 9, 1541-6 (Sep 1972).

The absolute skylight intensity and polarization were measured at 5577, 5780, 6100, and 6300 Å using an interference filter photometer mounted in a jet aircraft flying at an altitude of 12.2 km during the total solar eclipse of May 30, 1965. A value of 3 kR was obtained for the intensity of the OI 5577 Å $(^1S_0 - {}^1D_2)$ ionospheric dayglow emission. The results are compared with other recent measurements made during total solar eclipses. (auth)

51435 STARDUST. Hemenway, C. L.; Hallgren, D. S.; Schmalberger, D. C. (State Univ. of New York, Albany). Nature (London); 238: No. 5362, 256-60(4 Aug 1972).

Heavy metal particles have been detected in noctilucent clouds. Possible sources for these particles are considered and a solar origin is suggested. (auth)

51436 CURRENT RESEARCH ON MAGNETIC STORM PHENOMENA IN THE UPPER ATMOSPHERE. Jones, K. L. (Univ. of Queensland, Brisbane). Aust. Phys.; 9: No. 7, 99-100(Jul 1972).

Theories of ionospheric plasma processes are briefly reviewed, and a study program in experimental and theoretical ionospheric dynamics is briefly described. (Australia)

51437 EFFECTS OF DISTURBANCES IN THE OUTER IONOSPHERE IN DIFFERENT PHASES OF TWO SUCCESSIVE MAGNETIC STORMS DURING SEPTEMBER 1963. Fatkullin, M. N. Cosmic Res. (USSR) (Engl. Transl.): 10: No. 1, 60-7 (1972).

Translated from Kosm. Issled.; 10: No. 1, 73-81(1972).

An investigation of the distribution of the electron density in the F2 layer and in the outer ionosphere in distinct phases of two successive magnetic storms occurring on early September 13, 1963, and on September 16, 1963, was carried out on the basis of Alouette-1 satellite data. The average latitudes and local midday and midnight hours were given preference. It is shown that the electron density undergoes no changes during the principal phases of the two magnetic storms in the outer ionosphere at midday hours at several heights; below those levels the electron density falls off, and above those levels it rises. The electron density remains fairly high at all altitudes from h_mF2 to 1000 km in the midday hours, during the recovery phase of both magnetic storms. (auth)

51438 INTENSITY VARIATIONS OF EXCESS RADIATION AT ALTITUDES OF 200 TO 350 km. Tsaplin, V. S.; Shavrin, P. I.; Zubareva, L. V. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 1, 122-5(1972).

Translated from Kosm. Issled.; 10: No. 1, 136-40(1972).

From the beginning of 1965 to the end of 1969 (from minimum to maximum of the solar cycle), radiation measurements were made by the Cosmos satellites on orbits with apogee ~350 km, perigee ~200 km, and the angle of inclination to the equator 65°. The region of space in which the measurements were made is characterized by a minimum height of descent of the mirror-point drift trajectories $H_{min} < 0$ (except in the region of the Brazil anomaly), and thus, the detected radiation could not have been permanently trapped. The plots of intensity against time show a distinct variation with latitude with a peak in the region of the anomaly. The variation of the primary cosmic-ray component with latitude is shown for the period of minimum solar activity. Excess radiation is the ratio of the registered intensity to the primary cosmic-ray intensity $N_{reg}/N_{cr} \approx 10$ in the region of the equator and decreases to 3 or 4 at high latitudes. Information was analyzed for observations on 200 orbits for short-period variations in relation to amplitude, long-term variations in relation to solar-cycle activity, and variations of latitude distributions. (J.C.W.)

Effects of Nuclear Detonations

Refer also to abstract 51441.

Particle Kinetics and Trapping

Refer also to abstracts 50662, 51388, 51411, and 51413.

51439 (AD—738064) MECHANISM FOR BLOWOFF OF THE EARTH'S ATMOSPHERE: POPULATION OF THE VAN ALLEN BELT. Libby, L. Marshall (RAND Corp., Santa Monica, Calif.). Apr 1971. 23p. NTIS.

The rate of loss of terrestrial atmosphere from earthquake motions is estimated. Some of this atmosphere ionizes as it is blown off through the magnetosphere, and the amount so ionized seems to be abundantly ample to account for C, N, and O found in the Van Allen Belt. (auth) (NTIS)

51440 (AD—738316) NOISE IN THE NEUTRAL SHEET IN THE GEOMAGNETIC TAIL. Final Scientific Report, December 1, 1970—November 30, 1971. Dungey, James W. (Imperial Coll. of Science and Technology, London (England). Dept. of Physics). Jan 1972. Contract F61052-70-C-0009. 18p. (AFCRL—72-116). NTIS.

An instability that could cause noise in the neutral sheet is proposed. The starting point is the self-consistent model of the undisturbed sheet developed in the absence of a normal component of magnetic field by Cowley. In this steady state the electrons trapped in the field reversal region move across the tail from dusk to dawn, undergoing acceleration in the cross tail electric field at the dusk end. After emerging from the acceleration region only ions in this region are relatively cold. It was found that a wave propagating at an angle to the normal of the current sheet can be unstable due to a double jump in the velocity distribution. Resonating electrons give energy to the wave, while the wave energy probably leads to heating of the cold ion background. (auth) (NTIS)

51441 (AD—739495) TRANSIENT STRUCTURE OF AN ARTIFICIAL RADIATION BELT. Report for July—December 1971. Schulz, M. (Aerospace Corp., El Segundo, Calif.). 31 Mar 1972. Contract F04701-71-C-0172. 17p. (SAMSO-TR—72-58). NTIS.

Estimates are derived for the maximum flux (vs. azimuth) as a function of time following the detonation of a single source of radiation-belt electrons. All results are expressed in terms of the azimuthally averaged flux ultimately injected by the one event. (auth) (NTIS)

51442 (ESRO-SP—60) ESRO GEOSTATIONARY MAGNETOSPHERIC SATELLITE. Proceedings of an ESRO Colloquium Held at Lyngby, Denmark, 15—17 October 1969. (European Space Research Organization, Paris (France)). Mar 1971. 289p. (In French and English). (CONF-691070).

Twenty-nine papers presented at the conference at Lyngby, Denmark, Oct. 15—17, 1969, on ESRO Geostationary Magnetospheric Satellite are included here. A separate abstract was prepared for each of 20 papers; the remaining papers deal with the performance of the satellite, and were not abstracted for NSA. (J.C.W.)

For abstracts of individual papers see: 51404 and 51443—51461.

51443 (ESRO-SP-60, pp 1-29) REVIEW OF FIELDS AND PARTICLE OBSERVATIONS MADE IN THE VICINITY OF THE SYNCHRONOUS ORBIT. Axford, W. I. (Univ. of California, San Diego, La Jolla).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

The proposed ESRO geostationary satellite would greatly assist projects in observing almost all relevant space phenomena simultaneously from more than one position. The observations so far made from the vicinity of the synchronous orbit are surveyed and discussed. The magnetic field, low-energy cosmic rays, energetic trapped particles, auroral and ring-current particles, low-energy plasma in the magnetosphere, quasi-steady electric fields, low-frequency radio noise and line emissions are discussed. It is suggested that the back-up satellite be placed in elliptical orbit, between L = 4 and L = 8, in order to make correlations over all separations in longitude and across most of the auroral zone. (auth)

51444 (ESRO-SP-60, pp 31-48) MODELS OF MAGNETIC FIELD LINE GEOMETRY FOR A GEOSTATIONARY SATELLITE. Barish, F. D.; Roederer, J. G. (Univ. of Denver, Colo.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

A computer code for field-line calculations was developed, which takes into account magnetic-field contributions from external sources. A model magnetopause is assumed fixed in the solar–magnetospheric coordinate system and a model neutral sheet, oriented parallel to the ecliptic, is hooked onto the geomagnetic equator at a given distance from the Earth in the midnight meridian. Computed conjugate intersects for geostationary satellite field lines reveal a diurnal and seasonal variation. The shape of the diurnal conjugate trace is in general elliptic (sometimes with a secondary loop), with one of the axes roughly perpendicular to the direction of the local magnetic declination. The amplitude of the diurnal excursion increases with magnetospheric compression. The latter, in addition, causes appreciable shifts of the diurnal-average position of the conjugate point. The conjugate trace also varies with season, usually being largest during the solstice. (auth)

51445 (ESRO-SP-60, pp 49-68) EXPERIMENTAL RESULTS ON MAGNETIC CONJUGACY. Mariani, F. (Univ., Rome).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Ground-based, balloon and satellite data obtained during recent conjugate point experiments are reviewed. Investigations using long-duration magnetic-field variations and micropulsations, as well as particle precipitation, cosmic-noise, absorption, F-region ionospheric events, vlf and other electromagnetic phenomena, and optical observations are considered. More theoretical and experimental studies are required, but care must be taken concerning superimposed effects. The benefits derived from geostationary satellite measurements, which enable temporal variations to be analyzed without the complications arising from spatial variations, are stressed. (auth)

51446 (ESRO-SP-60, pp 69-78) MAGNETOSPHERIC PLASMA PHENOMENA AT THE GEOSTATIONARY ORBIT. Freeman, J. W. Jr.; Young, D. T. (Rice Univ., Houston, Tex.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

The principal phenomena detected by the low-energy plasma detector on board the ATS-1 geostationary satellite are reviewed. They can be classed as: directed flow of cool magnetospheric plasma; magnetopause plasma flow; plasma sheet dynamics; hydromagnetic-wave-induced plasma motion. The magnetosphere near the geostationary orbit is rich in phenomena accessible to a low-energy plasma detector on a spinning spacecraft; an instrument with a greater sensitivity and energy dynamic range than the ATS-1 would, however, be desirable. (auth)

51447 (ESRO-SP-60, pp 79-90 MACRO-INSTABILITIES IN THE MAGNETOSPHERE. Schindler, K. (ESRIN, Frascati, Italy).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

A number of plasma instabilities of the macroscopic type are considered in relation to their importance in the magnetosphere. The extent to which these instabilities can be detected at the geostationary orbit is discussed. It is concluded that mirror, exchange, and tearing instabilities may play an important part, whereas the Kelvin–Helmholtz instability, if excited on the magnetopause, probably does not have a large effect at L = 6.6. (auth)

51448 (ESRO-SP-60, pp 91-100) COMPLEX ELECTRIC FIELD EMISSIONS OBSERVED BY OGO-5 ON 15 AUGUST 1968. Kennel, C. F.; Scarf, F. L.; Coroniti, F. V.; Fredricks, R. W.; McGehee, J. H. Jr. (TRW Systems, Redondo Beach, Calif.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

OGO-5 results from the first broad-band electric-field experiment to operate successfully beyond the plasmapause are presented. They indicate that processes similar to those encountered in the laboratory may also operate in the magnetosphere. The wave electric- and magnetic-field data from a complex event observed on August 15, 1968 are discussed. Various types of electric-field emissions above the electron cyclotron frequency as well as electromagnetic chorus activity occurred near the geomagnetic equator on auroral lines of force near local midnight. This event was unusually complex but each wave type had been observed before. Details of the plasma wave detector and the dc and wave magnetic-field diagnostics are also given. (auth)

51449 (ESRO-SP-60, pp 101-6) LOW-FREQUENCY INTERACTIONS. Southwood, D. J. (London Univ.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

General features of wave–particle interactions are reviewed for waves at frequencies much less than the proton gyrofrequency. Emphasis is on a particular interaction that under certain conditions can result in amplification of an Alfvén wave. There is good evidence that such an instability has been observed on the ATS-1 geostationary satellite. (auth)

51450 (ESRO-SP-60, pp 107-10) EFFECT OF RESONANT INTERACTIONS ON OBSERVED FLUX. Dungey, J. W.; Southwood, D. J. (Imperial Coll. of Science and Tech., London).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

The linear effect of a wave on the observed flux of particles near resonance is discussed. Quantitative estimates of the sharpness of resonance and accompanying changes in observable parameters are calculated. (auth)

51451 (ESRO-SP-60, pp 111-18) PLASMAPAUSE. Thomas, J. O. (London Univ.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Facts about the plasmapause and its behavior are summarized as they are known at the present time. As a preliminary step, the experimental techniques for in situ measurements of the plasmapause profile are assessed critically and some of the difficulties encountered in low-density, thermal–plasma diagnostics are outlined. Experiments based on electrostatic-wave propagation seem to have some obvious advantages. (auth)

51452 (ESRO-SP-60, pp 119-44) MAGNETIC FIELD VARIATIONS AT ATS 1. McPherron, Robert L.; Coleman, Paul J. Jr. (Univ. of California, Los Angeles).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Magnetic-field variations observed with the magnetometer on the ATS-1 satellite are briefly described. These variations are classified according to whether they are macroscopic field changes or fluctuations and also whether they occur during quiet, disturbed (substorms), or very disturbed (storms) times. It is concluded that a complete understanding of these complex, interrelated phenomena still requires much detailed study. (auth)

51453 (ESRO-SP-60, pp 145-8) GEOSTATIONARY SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS. Rothwell, P. (Univ. of Southampton, Eng.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

In addition to geostationary satellite experiments for substorm investigations, other simultaneous experiments in the ionosphere, magnetosphere, and nearby interplanetary space are required. Magnetospheric electric fields, electron acceleration mechanisms in the magnetosphere and plasma sheet, wave–particle interactions during substorms, and the origin of the magnetospheric plasma are discussed, and the rapid dissemination of some geostationary satellite data is proposed. (auth)

51454 (ESRO-SP-60, pp 149-52) RESULTS FROM THE ESRO I LOW-ENERGY PARTICLE EXPERIMENT AND THEIR RELATION TO A GEOSTATIONARY SATELLITE PROJECT. Riedler, R. (Technische Hochschule, Graz, Austria).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

The results from the S.71 B low-energy particle spectrum experiment on board the ESRO-I satellite are discussed, and conclusions are drawn concerning the possibility of mounting a similar experiment on a geostationary satellite. (auth)

51455 (ESRO-SP-60, pp 155-8) MAGNETOSPHERIC SUBSTORMS: GEOSTATIONARY SATELLITE INVESTIGATIONS IN RELATION TO GROUND-BASED OBSERVATIONS. Hultqvist, Bengt (Kiruna Geophysical Observatory, Sweden).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

It is suggested that because satellite particle measurements relate to a smaller volume of space they should have priority over magnetic- and electric-field measurements. The need for ground-based substorm measurements from N. Scandinavia, Spitzbergen, Bear Island, Iceland, Greenland, Jan Mayen, as well as from Soviet and N. American sites is stressed. Data processing requirements are also discussed. (auth)

51456 (ESRO-SP-60, pp 163-74) PERIODIC VARIATIONS OF ELECTRON FLUXES OBSERVED AT SYNCHRONOUS ALTITUDES. Parks, George K. (Univ., Toulouse).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Temporal analysis of electron fluxes detected at synchronous altitudes indicates that the commonly observed periodic variations in the precipitated fluxes also persist in the equatorial electrons with large pitch angles. The dynamic spectral analysis of twenty consecutive days of electron data indicates that the substorm-correlated increases of electrons observed in the equatorial plane have a recurrence period of about 2.5 hours. Faster fluctuations are also observed within the substorm period. These include variations of a few minutes period and the more rapid 5- to 40-second periods. (auth)

51457 (ESRO-SP-60, pp 175-7) COORDINATED STUDIES OF PRECIPITATED ELECTRONS BY GEOSTATIONARY SATELLITE AND BALLOONS. Trefall, Harald (Univ. of Bergen).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Examples of the local time variations of the spatial character of electron precipitation events over Northern Scandinavia are discussed. Conjugate points may move around by several hundred kilometers a day, and useful simultaneous balloon and satellite measurements can only be made when the conjugate point is within about 100 km of the balloon. Balloon launchings from a north–south chain of stations across the auroral zone in order to determine the latitude, and possibly the longitude, of the point conjugate to the satellite are proposed. New balloon and satellite instruments are also proposed. (auth)

51458 (ESRO-SP-60, pp 183-99) CHARGED PARTICLE EMISSION FROM A GEOSTATIONARY SATELLITE. Stauning, Peter (Ionosphere Lab., Lyngby, Denmark).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

A quantitative model is derived for the interaction of a satellite emitting charged particles with an ionized medium characterized by satellite radius < Debye length < electron gyro radius. In a numerical evaluation of the I–V characteristic for the idealized representation of a geostationary satellite, realistic values for the outer magnetosphere plasma densities, temperature and magnetic fields were used. It is shown that the emission of rather small currents of energetic particles can cause considerable changes in the satellite equilibrium potential. Changes of several hundred volts were found for electron or ion currents of about 1 mA. It is suggested that such a capability should be included in the payload of the ESRO geostationary satellite for optimizing the operational conditions for plasma and electric-field experiments, investigating plasma parameters, resonances, and instabilities, and for studying the precise interaction of a spacecraft with a dilute ionized medium. (auth)

51459 (ESRO-SP-60, pp 201-12) AN ACTIVE RADIOWAVE EMISSION EXPERIMENT. Petit, M. (CNET, Issy-les-Moulineaux, France).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

New active radiowave emission experiments are proposed for the four frequency ranges, (a) 50 MHz (Faraday effect), (b) 100 kHz (topside plasmapause observations), (c) 3 to 10 kHz (resonance studies), and (d) 1 to 3 kHz (low-frequency wave emissions, including an artificially stimulated wave). (auth)

51460 (ESRO-SP-60, pp 213-22) PRELIMINARY PROPOSAL FOR EXPERIMENTS ON THE ESRO GEOSTATIONARY SATELLITE (GEOS). Martelli, G.; Troughton, J. (Univ. of Sussex, Brighton, Eng.).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

Proposed geostationary satellite experiments concerning the magnetospheric knee, plasma resonances, and plasma-wave noise are discussed. (auth)

51461 (ESRO-SP-60, pp 267-79) ELECTRIC FIELD EXPERIMENTS: ALTERNATING FIELDS. Storey, L. R. O. (CNRS, Saint-Maur-des-Fosses, France).

From The ESRO geostationary magnetospheric satellite conference; Lyngby, Denmark (15 Oct 1969).

The characteristic frequencies of the ambient plasma and the properties of the electromagnetic and electrostatic waves propagating through it are described. The difficulties of using three different kinds of antenna are listed, and the joint problems of field measurement and interpretation for simple plane waves as well as complex random wave fields are discussed for both electromagnetic and electrostatic waves, and recommendations for future theoretical and experimental studies are made. (auth)

51462 (ESRO-SP-72) WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE. Proceedings of a Colloquium Held in Orleans, France, 17–19 March 1971. (European Space Research Organization, Paris (France)). Aug 1971. 288p. (CONF-710351).

Thirty-one papers were presented at the colloquium. They concern large-scale dynamics of the magnetosphere, distribution of plasma parameters, decoupling of magnetospheric from ionospheric plasma, acceleration and convection mechanisms, substorms, polar wind, as well as the theoretical and experimental work needed to solve these problems in the light of previous experiments, and of technical achievements (onboard computers, new sensors). Ensuing discussions attempted to define types of missions which could be carried out in the future by the small scientific satellites now being considered by ESRO. Twenty-two papers were abstracted separately; abstracts only were included for eight papers; and one paper was out of scope for NSA. (France)

For abstracts of individual papers see: 51405–51413 and 51463–51475.

51463 (ESRO-SP-72, pp 5-16) WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE. Eviatar, Aharon (Tel-Aviv Univ., Israel).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

A short introduction to the basic equations of linear and quasilinear plasma kinetic theory is given. Some applications of these results to observed particle phenomena in the magnetosphere are reviewed. The creation of populations of energetic ions by magnetohydrodynamic waves is considered and the effects of the existence of such ions on the stability of electromagnetic waves are discussed in the light of the observations made during the magnetic storm of April 18, 1965. Electrostatic ion waves are reviewed in the context of the polar wind. The state of knowledge of electron–wave interaction is surveyed. Various models involving whistlers, electrostatic modes, and electromagnetic radiation normal to the field lines are discussed as means of explaining the observed particle lifetimes, diffusion processes, and the local acceleration phenomena. The vast lacunae in the present understanding of magnetosphere plasma physics are delineated. (auth)

51464 (ESRO-SP-72, pp 17-33) THEORY OF VLF EMISSIONS. Nunn, D. (Imperial Coll. of Science and Tech., London).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The work attempts a theoretical explanation of the phenomenon of artificially triggered vlf emissions. First, resonant-particle trajectories in a narrow-band whistler wave in an inhomogeneous medium are studied. It is found that second-order resonant particles become stably trapped in the wave. After one or two trapping periods, these particles can make a dominant contribution to the resonant particle current. A realistic zero-order distribution function is selected, involving a source of potential energy in the form of a loss cone. The resonant-particle currents are computed for the case of a constant-amplitude whistler crossing the magnetospheric equator. The results tend to explain many of the features of triggering. The equations governing the time development of the wave field due to the presence of a resonant-particle current are developed. Resonant-particle currents are computed for various generation region type field configurations. These results enable the problem of a self-consistent description of a generation region to be discussed. (auth)

51465 (ESRO-SP-72, pp 37-40) QUASI-LINEAR CALCULATION OF VLF HISS SPECTRUM. Etcheto, J.; Roux, A.; Singh, R. P.; Solomon, J. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

It is assumed that the emission to vlf waves is a result of cyclotron interaction of energetic electrons with the whistler mode. If the wave frequencies are much smaller than the electron gyrofrequency energy, energy diffusion of the particles can be neglected. In this case, the distribution function of the energetic electrons and the wave magnetic field must satisfy the coupled equations of pitch-angle diffusion and wave energy conservation. The steady-state case is considered and it is assumed that a given anisotropic particle source maintains a constant anisotropic distribution function of energetic electrons. The inhomogeneity of the medium is taken into account and the equilibrium spectrum of the waves is calculated for different values of anisotropy and mean velocity of the energetic electrons of the source. This case is applicable to continuous emissions of low-level vlf hiss associated with continuous electron precipitation. The spectra obtained are similar to those recently measured from OGO 3 and Ariel 3. (auth)

51466 (ESRO-SP-72, pp 63-77) WAVE–PARTICLE INTERACTION IN THE PLASMASPHERE. Haerendel, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The observed particle populations inside the plasmasphere and their variations are governed by the gyroresonant interaction with electromagnetic plasma waves of low frequency; four topics are covered. After an introduction, Section 2 described the mathematics of the gyroresonant wave-particle interactions. The formal advantage of a special choice of momentum variables is demonstrated. Section 3 deals with the penetration of protons through the plasmapause, i.e., with the sudden transition from a hot to a cold plasma background. Enhanced pitch-angle scattering and the emission of certain ulf waves has been attributed to it. The stationary distribution of electrons inside the plasmasphere and the origin of the "slot" are discussed in Section 4. In Section 5, the interaction of electrons and protons by means of emission and absorption of whistler-mode waves (elf waves) were considered. (J.C.W.)

51467 (ESRO-SP-72, pp 81-2) STRUCTURE OF THE GEOMAGNETIC TAIL. Schindler, Karl (European Space Research Inst., Frascati, Italy).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

It seems widely accepted that the plasma sheet in the tail of the geomagnetosphere plays an important role in a number of magnetospheric processes. However, it is shown by comparing the various models proposed, that the properties of the plasma sheet are yet unknown. (France)

51468 (ESRO-SP-72, pp 83-92) NONLINEAR THEORY OF TYPE-I IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Rogister, Andre (European Space Research Inst., Frascati, Italy).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The nonlinear development of the Farley–Buneman instability in the equatorial electrojet is considered. The stabilization mechanism is as follows: a turbulent (negative) vertical electron flux develops in the turbulent layer; in order to preserve charge neutrality, the (positive) vertical ion flux decreases accordingly. Hence, the secondary electric field and the electrojet electron current also decrease, thereby quenching the instability. The predictions of the theory agree quite well with available experimental evidence. (auth)

51469 (ESRO-SP-72, pp 157-61) MAGNETOSPHERIC STRUCTURE DEDUCED FROM WHISTLER OBSERVATIONS AT HALLEY BAY. Sagredo, J. L.; Bullough, K. (Univ. of Sheffield, Eng.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Whistlers observed at Halley Bay (333.4°E; 75.5°S; 60.7° invariant latitude) on July 26, 1967, extending through the period 0509 to 2305 UT, were found to have exit points situated along a strip about 100 km wide, passing through Halley Bay in an azimuthal direction 30° E of N between 57 and 62° invariant latitude. A mechanism that can give rise to such a well-defined locus that co-rotates with the Earth is not clear. Nevertheless, it does appear that the locus coincides with the contour of solar-zenith angle 102° at 1800 UT July 25. This was also the time of occurrence of a substorm and it is suggested that the magnetospheric structure was initiated by proton precipitation along the solar-zenith angle 102° contour. (auth)

51470 (FSRO-SP-72, pp 163-73) DAWN–DUSK ELECTRIC FIELDS ACROSS THE MAGNETOSPHERE DERIVED FROM PLASMAPAUSE OBSERVATIONS. Rycroft, M. J. (Univ. of Southampton, Eng.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Whistler observations of the position of the plasmapause presented by Carpenter have been analyzed statistically by Rycroft and Thomas. The inward motion of the plasmapause, associated with increased magnetic activity and with increasing local time during the night, is interpreted quantitatively using a theory developed by Shield. It is shown that the average dawn-dusk electric field across the tail of the magnetosphere, due to the interaction of the solar wind with the geomagnetic field, increases linearly from 0.7 kv/R_E at $K_p = O_o$ to twice that value, namely 1.4 kV/R_E, at $K_p = 5-$. (auth)

51471 (ESRO-SP-72, pp 175-86) GYRORESONANT WAVE–PARTICLE INTERACTIONS IN A SPATIALLY VARYING MAGNETIC FIELD AND PLASMA DENSITY. Troughton, J.; Martelli, G. (Univ. of Sussex, Brighton, Eng.).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Solutions of the linearized non-relativistic equations of motion of an electron in the fields of a right-hand circularly-polarized electromagnetic (whistler-mode) wave propagating in a direction parallel to a magnetic field in a magneto-active plasma are considered. The magnetic field and plasma density are assumed to vary in space along the direction of propagation. The gyroresonance condition for the wave-particle interaction is satisfied only at one point in space. A comparison of the exact trajectories of the particles (obtained by integrating numerically the equations of motion) with the solutions of the linearized equations shows that the latter give a good representation of the motion as long as the initial pitch angle of the particle < 10 deg, and the magnetic field and plasma density show a spatial variation that is greater than a certain minimum variation. When these conditions are satisfied, as they are in fact in most regions of the Earth's magnetosphere, the linearized equations yield simple expressions for the change of the pitch angle of the particle. These results are used to illustrate pitch-angle scattering of electrons interacting with vlf radiation in the Earth's magnetosphere. (auth)

51472 (ESRO-SP-72, pp 241-8) FAST ANALYSIS OF PITCH-ANGLE AND ENERGY DISTRIBUTION OF ENERGETIC PROTONS. Etcheto, J.; de la Porte des Vaux, B. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The principle of a new method of measuring the pitch-angle distribution of protons is described. A position-sensitive solid-state detector is used to determine the angle of arrival of the protons with respect to the detector axis. This device is capable of measuring the energy and angle of arrival of 10^4 particles per second. Two methods of using the device depending on the telemetry bandwidth available are presented. This device can measure the pitch-angle distribution of medium-energy protons very quickly and precisely. Such applications to the study of wave–particle interactions are suggested in the region of interest compared with the characteristic time periods of substorms. (auth)

51473 (ESRO-SP-72, pp 249-57) STUDY OF PLASMA RESONANCES WITH A SINGLE ANTENNA. Petit, Michel (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

Plasma resonances, detected with a single antenna, can provide reliable measurements of electron density and electron gyrofrequency. The physics of this phenomenon are not yet completely explored, and more information is likely to be obtained from the detailed structure of the ringing signals received after transmitting a pulse at a certain resonance frequency (i.e., variation of amplitude and wave form with time delay). The experimental setup can be designed to study both resonances and natural waves without unduly complicating the onboard system. (auth)

51474 (ESRO-SP-72, pp 261-3) MAGNETOSPHERIC STUDIES AT 10 EARTH RADII. Haskell, G. P. (Imperial Coll. of Science and Tech., London).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

It is suggested that the most fundamental problem in the physics of the magnetosphere is the problem of the substorm. In particular, it is important to ascertain whether substorms are triggered by changes in the solar wind or by an internal instability of the magnetosphere in which wave-particle interactions may play an important part. Further, it is suggested that the region of space near 10 R_E in the equatorial plane is especially suitable for experimental studies of this problem. Satellite orbits with apogees close to 10 R_E are needed because it is important that the satellite should spend a long time in the region of interest compared with the characteristic time periods of substorms. (auth)

51475 (ESRO-SP-72, pp 265-70) STUDY OF INTERACTIONS IN THE MAGNETOSPHERE AND THE ESRO PROGRAM. du Castel, F. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). (In French).

From Conference on wave-particle interactions in the magnetosphere; Orleans, France (17 Mar 1971).

The possibility of including a small magnetospheric satellite program was studied by ESRO. Some of the orbits proposed are presented: either low-altitude orbits or large-apogee orbits. The experiments envisaged concern wave measurements (magnetic or electric). Particle measurements necessary to study interaction phenomena, and complementary measurements for the determination of environmental conditions (thermal plasma and magnetic field) are presented. (France)

51476 POLARIZATION OF GEOMAGNETIC PULSATIONS. Van'yan, L. L.; Abramov, L. A.; Gokhberg, M. B.; (and others) (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 6, 890-2(1971).

Translated from Geomagn. Aeron.; 11: No. 6, 1061-4(1971).

Proceeding from the hypothesis of a local source of SPP with a period of several minutes, it is demonstrated that for a point electric dipole the horizontal magnetic field has the same direction of rotation everywhere, except in the first hundred kilometers under the projection of the source onto the ionosphere. An analysis of observational data on the instantaneous direction of rotation of the field of magnetic pulsations supports this viewpoint qualitatively. This indicates that the separation of Pc3 and Pc4 pulsations into "morning" and "evening" types applies also to the direction of rotation of their source. (auth)

51477 KINETIC THEORY OF DENSITY FLUCTUATIONS IN A MAGNETIZED COLLISION-DOMINATED PLASMA IN AN ELECTRIC FIELD. Hagfors, T. (Massachusetts Inst. of Tech., Cambridge); Power, R. A. J. Geophys. Res.; 77: No. 22, 4190-6(1 Aug 1972).

A kinetic theory of electron-density fluctuations in a magnetized collision-dominant plasma in an electric field is developed on the assumption of stable conditions. The effect of the electric field on the total power scattered from the plasma is very small, but the spectral shape of the predicted scattering is substantial. Some spectra are computed for conditions that might prevail in the lower ionosphere. The results are compared with those of Seasholtz (NSA 25:22420) who considered the same problem on the basis of hydrodynamic theory. The results of the two approaches are in good qualitative agreement, but there are some differences in the details of the spectral predictions. (auth)

51478 EXTERNAL PRODUCTION AND CONTROL OF ELECTROJET IRREGULARITIES. Lee, K.; Kaw, P. K.; Kennel, C. F. (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 22, 4197-4208(1 Aug 1972).

Parametric coupling of a large-amplitude pump wave to a natural plasma mode of the ionospheric E layer was analytically investigated. It is shown that the E-layer plasma mode can be either stabilized or destabilized by the parametric process. Two necessary conditions for parametric interaction are (1) near frequency matching (i.e., the pump-wave frequency should be near the local upper hybrid frequency) and (2) a finite electric-field component of the pump wave perpendicular to the background static magnetic field. An investigation of the propagation characteristics of the pump wave in the magnetic equatorial region indicates that an obliquely propagating O mode in the magnetic meridian plane meets the two necessary conditions in an optimal manner. From typical values of ionospheric parameters it is estimated that the required incident energy flux of the pump wave for parametric stabilization or destabilization of the E-layer plasma mode (near its natural marginal stability) is $\ll 1$ mW/m^2. Thus parametric coupling experiments for the ionospheric E layer are technically feasible. (29 references) (auth)

51479 SPECTRUM OF THE GEOMAGNETIC ACTIVITY INDEX Ap. Fraser-Smith, A. C. (Stanford Univ., Calif.). J. Geophys. Res.; 77: No. 22, 4209-20(1 Aug 1972).

The ionospheric propagation of high-frequency radio waves is profoundly influenced by the variations of sunspot numbers and of geomagnetic activity. Thus, details of these variations and of the relationship between them have practical application. The variation of the geomagnetic activity index Ap over the 38-year interval January 1932 through January 1970 differs in several important characteristics from the variation of sunspot numbers over the same interval. A spectral analysis was used to investigate this variation of Ap, as well as its relation to the variation of sunspot numbers. The data analyzed consisted of the 457 monthly average Ap indices ⟨Ap⟩ for the 38-year interval and the corresponding observed monthly sunspot numbers. A large 23-year sample of the original daily Ap indices was also analyzed. The ⟨Ap⟩ spectrum was found to be characterized by seven distinct lines with periods, in order of their relative line amplitudes, of 35.2 and 10.2 years, 6.0 months, 16.1, 7.0, 4.1, and 5.1 years. The lines with periods of 16.1, 7.0, and 5.1 years are not considered to be fundamental; they appear to be either harmonics or side frequencies of the two strongest lines. The 10.2-year line in the ⟨Ap⟩ spectrum was matched by a sunspot line at exactly the same period. However, the sunspot cycle preceded the ⟨Ap⟩ cycle by 18 months. The semiannual variation had maximums close to the equinoxes. The uncertainty in the dates of the maximums was of the order of a few days, so that the results clearly support the equinoctial hypothesis for the origin of the semiannual variation. A possible origin in the solar corona is indicated for the 4.1-year line. The spectrum of the daily Ap indices was not dominated by the 27-day geomagnetic storm recurrence period, presumably because of the variation of this period over a solar cycle. Apart from an expected solar-cycle component and its associated lines, the eight largest lines in the spectrum for the 23-year interval of Ap data occurred at periods of 6.0 months, 1.47 years, 27.2 and 27.6 days (a doublet), 1.23 months, 1.09 years, 13.7 and 14.1 days. There was no evidence for either an annual variation or a variation at the lunar synodic period. (30 references) (auth)

51480 STUDIES OF OUTER BELT AND SLOT REGION PROTONS AT LOW ALTITUDES. Imhof, W. L.; Reagan, J. B. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). J. Geophys. Res.; 77: No. 22, 4128-44(1 Aug 1972).

A detailed investigation was made of the fluxes and spectra of protons 1.4 to 46 MeV and >70 MeV measured in the outer belt and slot region at low altitudes (<600 km). The data used in this study were taken with a proton spectrometer on board the OV1-18 satellite during the period March 1969 to June 1970. The intensities underwent significant changes during this time interval, but the general shapes of the flux versus B contours were relatively time independent. On the lower L shells the fluxes of the lower-energy protons fell off with increasing B as expected for the dominance of atmospheric losses. On higher L shells the flux profiles became less steep with increasing L value for a given proton energy and on a given L shell became less steep with increasing energy. The deviations from the atmospheric predictions were much greater than the variations between the atmospheric models used. The observed fluxes of the lower-energy protons trapped on field lines up to rather high L values were too large to be attributed to the cosmic-ray albedo neutron source alone. The flux profiles of the protons at low altitudes were compared also with those expected if the source mechanism is inward radial diffusion under conservation of the first two invariants. The shapes of the flux profiles cannot be accounted for by this process if values for the diffusion coefficients available in the literature are used. (51 references) (auth)

51481 RECONNECTION OF THE GEOMAGNETIC TAIL DEDUCED FROM SOLAR-PARTICLE OBSERVATIONS. Morfill, G.; Scholer, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Geophys. Res.; 77: No. 22, 4021-6(1 Aug 1972).

It is shown that particle intensity structures bounded by magnetic discontinuities and convected past the Earth with the solar wind favor an open-tail interpretation. By using polar-cap measurements of these discontinuities expressed in a new system described by Morfill (1972) the average reconnection rate between the interplanetary and magnetospheric field lines is calculated. Furthermore, the cross-tail electric field, the mean free path in the tail, and the transverse component of power in the fluctuations of the tail magnetic field at the particle gyrofrequency are derived. (25 references) (auth)

51482 INTERPLANETARY MAGNETIC-SECTOR STRUCTURE, 1926-1971. Svalgaard, L. (Danish Meteorological Inst., Copenhagen). J. Geophys. Res.; 77: No. 22, 4027-34(1 Aug 1972).

The influence of the direction of the interplanetary magnetic field on the geomagnetic field at high latitudes is used to study the long-term behavior of the sector structure during nearly four solar cycles. It is found that the rotation period of the sector structure varies from about 28.5 days in the beginning of a solar cycle to 27.0 days in the end. Also it is shown that short-lived sectors rotate more slowly than long-lived ones. (auth)

51483 PULSE PROPAGATION IN A MAGNETOPLASMA. I. LONGITUDINAL PROPAGATION. Seyler, C. C. Jr.; Bloch, S. C.; Flynn, R. W. (Univ. of South Florida, Tampa). J. Geophys. Res.; 77: No. 22, 4237-41(1 Aug 1972).

The propagation of electromagnetic-wave pulses parallel to the static magnetic field in a magnetoplasma with finite collision frequency is treated numerically by means of the fast Fourier transform. This method can be used with almost any dispersion relation; results here are obtained with the Appleton–Hartree dispersion relation. With a rectangular incident pulse envelope, the transmitted pulse shapes for both left and right circularly polarized waves are obtained as functions of ω_p/ω, ν/ω, ω_b/ω, and the number of vacuum wavelengths in the propagation path. The effect of even small ν/ω markedly differs from the collisionless case. (auth)

51484 PROPAGATION OF VERY LOW-FREQUENCY WAVES IN DUCTS IN THE MAGNETOSPHERE. II. Walker, A. D. M. (Rhodes Univ., Grahamstown, S. Afr.). Proc. Roy. Soc. (London), Ser. A; 329: No. 1577, 219-31(8 Aug 1972).

Because of transverse gradients of refractive index, magnetospheric ducts that guide whistlers are not isolated. The whistlers are likely to leak from the ducts through a forbidden region owing to barrier penetration by evanescent waves. This phenomenon is investigated theoretically by using the WKBJ approximation and phase integral methods. A new type of mode called a quasi-trapped mode is discussed. It is shown that, if a wave packet is incident on a duct capable of sustaining quasi-trapped modes, certain components of its angular spectrum are selectively trapped. These travel in quasi-trapped modes for considerable distances before leaking from the duct. Expressions are derived for the distance traveled in terms of the width of the duct, the width of the barrier region, and the properties of the medium. A connection between this type of solution and a solution in terms of leaky modes is discussed. (auth)

51485 THREE-DIMENSIONAL, ANALYTICAL MAGNETOSPHERIC MODEL WITH DEFINED MAGNETOPAUSE. Voight, G.-H. (Technische Univ., Brunswick). Z. Geophys.; 38: No. 2, 319-46(Jul 1972).

The three-dimensional magnetospheric model is based on a given magnetopause geometry assumed to be parallel to the magnetic field. Accordingly no connection exists to the interplanetary magnetic field that is assumed to be zero. The magnetopause is represented as a half-sphere on the dayside and a semi-infinite cylinder with constant radius on the nightside (geomagnetic tail). The neutral sheet is assumed to be an infinitesimal thin current sheet with a constant current distribution. These currents are limited by the diameter of the tail. The Chapman–Ferraro currents on the dayside and the neutral sheet return-currents on the nightside of the magnetopause result as the solution of the second boundary value problem of potential theory. The result is an analytical solution within the whole magnetospheric cavity with respect to the chosen geometry of the magnetopause. The magnetic field of these boundary currents together with the Earth's dipole field and the field of the neutral-sheet currents form the final magnetic-field configuration within the magnetosphere. Magnetic disturbances and shifting of the polar oval can be simulated by variation of the model parameters. The model parameters are: the stand-off distance to the subsolar point, the location of the inner edge of the neutral sheet, the magnetic field produced by the neutral-sheet currents, and the radius of the magnetosphere. The field-line configuration of the model has been computed in the noon-midnight meridian plane for several sets of model parameters. It is shown that the location of the neutral points depends strongly on the stand-off distance. The resulting day-night asymmetry of the magnetic field in the equatorial plane of the model was verified by ATS-1 measurements. (auth)

Solar Wind and Cosmic Ray Interactions

Refer also to abstract 51433.

51486 SEA-LEVEL MUON SPECTRUM AT TWO DIFFERENT LATITUDES. Allkofer, O. C.; Andresen, R. D.; Clausen, K.; Dau, W. D. (Univ., Kiel). J. Geophys. Res.; 77: No. 22, 4251-3 (1 Aug 1972).

The momentum spectra and charge ratios of cosmic-ray muons at sea level were determined in the range 0.3 to 26 GeV/c at the equator (vertical cutoff rigidity $P_c = 14$ GV) and at Kiel ($P_c = 2.3$ GV). The measurements were performed by means of a magnetic spectrograph using spark-chamber technique. There is a significant difference between the spectra for momentums smaller than 1 GeV/c; however, there is agreement as far as the charge ratios are concerned. The total latitude effect amounts to 15%. (auth)

51487 COSMIC-RAY DIFFUSION COEFFICIENT IN INTERPLANETARY SPACE. Gleeson, L. J.; Urch, I. H. (Monash Univ., Clayton, Australia). J. Geophys. Res.; 77: No. 22, 4259-67(1 Aug 1972).

Burger et al. concluded in three recent papers reporting cosmic-ray electron differential intensities near the Earth during 1966 and 1968 in the rigidity range above 500 MV that the observations are not compatible with a diffusion coefficient that can be written as a product of a rigidity-dependent part and a part that is a function of heliocentric distance. It is shown that, with an interstellar electron spectrum and a near-Earth spectrum given, a diffusion coefficient of the form given can always be determined, and the conclusion noted cannot be sustained. Diffusion coefficients appropriate to the observations are given. A reply by Burger is included. (auth)

51488 COORDINATE SYSTEM FOR USE WITH HIGH-LATITUDE ENERGETIC-PARTICLE PHENOMENA. Morfill, G. (Max-Plack-Institut fuer Physik und Astrophysik, Munich). J. Geophys. Res.; 77: No. 22, 4010-20(1 Aug 1972).

The coordinate system generally used to describe the structure of solar-particle profiles over the polar caps is based on invariant latitude and magnetic local time. By using trajectory integrations in a model geomagnetic field, a new coordinate system is developed that is not based on internal geomagnetic-field components alone but also takes into account the currents flowing in the magnetopause and the neutral sheet. It is shown that the new coordinate system is more relevant for the interpretation of high-latitude energetic-particle data than the old system and that its use makes it possible to calculate reconnection rates and scattering mean free paths in the tail. In a companion paper the results of the calculations performed here are applied to observations first to decide which magnetosphere model (open or diffusive) is appropriate and second to use the solar-particle data for making measurements of important magnetospheric parameters. (23 references) (auth)

51489 COLLISIONLESS SOLAR WIND PROTONS: A COMPARISON OF KINETIC AND HYDRODYNAMIC DESCRIPTIONS. Leer, Egil (Univ. of California, San Diego, La Jolla); Holzer, Thomas E. J. Geophys. Res.; 77: No. 22, 4035-40(1 Aug 1972).

Kinetic and hydrodynamic descriptions of a collisionless solar wind proton gas are compared. Heat conduction and viscosity are neglected in the hydrodynamic formulation but are automatically included in the kinetic formulation. The fact that the results of the two models are very nearly the same indicates that heat conduction and viscosity are not important in the solar wind proton gas beyond approximately 0.1 AU. It is concluded that the hydrodynamic equations provide a valid description of the collisionless solar wind protons and, hence, that future models of the quiet solar wind should be based on a hydrodynamic formulation. (46 references) (auth)

51490 SOLAR-WIND PROPERTIES AT THE EARTH AS PREDICTED BY ONE-FLUID MODELS. Durney, B. R. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res.; 77: No. 22, 4042-51(1 Aug 1972).

The spiraling magnetic field of the Sun reduces the electron conductivity κ by the factor $\cos^2 \theta$, where θ is the spiral field angle. For a variety of values of the density and temperature at the base of the corona, one-fluid solar-wind models for thermal conductivities equal to κ and $\kappa \cos^2 \theta$ were computed. For both cases, the values of the computed solar-wind parameters at the Earth are compared with observed properties. (43 references) (auth)

51491 HELIUM ABUNDANCE VARIATIONS. Ogilvie, K. W. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 77: No. 22, 4227-32(1 Aug 1972).

Observational data of the solar wind by Explorers 34 and 43 confirm the existence of a linear relationship between the relative abundance of helium η_α/η_p and the bulk speed U of the wind, recently described by Hirshberg, Asbridge, and Robbins. Use of this relationship $\eta_\alpha/\eta_p = a(t) + bU$ allows the dependence of the relative abundance of helium on solar activity to be separated from its dependence on bulk speed. The proportion of helium in the solar wind at a given bulk speed is found to increase with increasing sunspot number, averaged over the period of observation. It is shown that the relationship between average relative abundance and temperature, deduced by using the bulk speed–temperature relation, is consistent with the data. The relative abundance of helium is not found to increase with increasing solar-wind flux. This confirms the result of Hirshberg et al. (auth)

51492 AZIMUTHAL PROPAGATION OF LOW-ENERGY SOLAR-FLARE PROTONS AS OBSERVED FROM SPACECRAFT VERY WIDELY SEPARATED IN SOLAR AZIMUTH. McKibben, R. Bruce (Univ. of Chicago). J. Geophys. Res.; 77: No. 22, 3957-84(1 Aug 1972).

The azimuthal propagation of solar protons with kinetic energies in the range ~10 to ~30 MeV was investigated by using observations made in the period December 1967 through August 1968 with University of Chicago instruments on board the Earth satellite Imp 4 and the deep-space probes Pioneer 6 and Pioneer 7, which were very widely separated from the Earth during this period. In the period studied, nine solar-proton events were observed simultaneously at all three spacecraft. In 6 of the 9 events discussed, the proton fluxes approached uniformity around the Sun at the orbit of Earth, and in 5 of these 6, the decay was divisible into 2 phases. During phase 1 azimuthal gradients were strong and the decay of the flux was fast, with exponential time-decay constants in the range ~10 to 20 hrs. During phase 2, azimuthal gradients were weak or nonexistent and decay was slow, with time constants generally in excess of 40 hrs. The times required for rise to maximum intensity and approach to uniformity, if interpreted in terms of the 1967 model of L. F. Burlaga, are found consistent with the existence of diffusion coefficients $\kappa_{||} > 4.3 \times 10^{20}$ cm^2/sec and $\kappa_{\perp} \sim 10^{20}$ to 10^{21} cm^2/sec at the orbit of Earth. From observations of the energy spectra of the protons in these events, it is concluded that the azimuthal propagation process did not depend strongly on particle energy and that consequently there was no simple general dependence of the spectral form on azimuthal separation from the flare site. Though detailed interpretation and discussion of the theoretical implications of these results are deferred to a later paper, alternative models for the understanding of the observations are mentioned briefly. (32 references) (auth)

51493 SEVERAL OBSERVATIONS OF LOW-ENERGY SOLAR-PROTON SPECTRA AND POSSIBLE INTERPRETATIONS. Verzariu, P.; Krimigis, S. M. (Johns Hopkins Univ., Silver Spring, Md.). J. Geophys. Res.; 77: No. 22, 3985-98(1 Aug 1972).

The differential energy spectrum of solar protons in the range 0.3 to 25 MeV obtained with the Injun-5 polar-orbiting satellite is examined for several solar-particle events. Of these, the events of February 25, 1969, April 26, 1969, and March 6, 1970, are discussed in detail. Except for the spectra observed early in the event, which are consistent with diffusive velocity dispersion effects, it is found that the majority of the events exhibit undistorted monotonically decreasing ($\sim E^{-\gamma}$) spectra within the energy range measured. The solar-particle events of April 26, 1969, and March 6, 1970, produced spectra late in the event, implying energy degradation of the very-low-energy solar protons. By using one of the degraded spectra (March 8, 1970) it was found that the energy degradation could be explained by (1) postulating a temporary storage region $\gtrsim 3$ to 7 R_s above the photosphere or (2) requiring continuous acceleration and emission of particles at the Sun in the manner discussed by Parker (1965). Present theoretical and observational evidence indicates that the magnetic trapping is effective only to an altitude of about 1 R_s above the photosphere, whereas the data here suggest higher coronal trapping regions for the low-energy protons. If it is assumed that closed-field structures are necessary for particle confinement, one must conclude that alternative 2 is more plausible in explaining the observations. The effects of curvature and gradient drifts on the stored particles are computed by assuming a dipole-like trapping region extending to 1 R_s above the photosphere. It is found that these drifts are ineffective in depleting the trapping region of low-energy protons (1 to 10 MeV) and that for typical confinement times of $\sim 10^5$ sec most of this low-energy component of flare-generated particles should be lost to the photosphere owing to ionization losses. (55 references) (auth)

51494 GEOMAGNETIC CUTOFFS FOR COSMIC-RAY PROTONS FOR SEVEN ENERGY INTERVALS BETWEEN 1.2 AND 39 MeV. Fanselow, J. L.; Stone, E. C. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 77: No. 22, 3999-4008 (1 Aug 1972).

The vertical geomagnetic cutoffs for cosmic-ray protons are presented for seven different energy intervals between 1.2 and 39 MeV. These data, representing approximately 160 passes through the cutoff, were taken during 1967 and 1968, between 408- and 912-km altitude, during times of $K_p < 1^+$. These passes provide nearly an order of magnitude more data during geomagnetically quiet times than have been previously reported at even one of these energies. In addition, the energy resolution of the instrument was significantly better than that of previous instruments. With these data, it is found that the measured invariant latitudes for the cutoffs are 3 to 5° below previous calculations. No correlation of these observations with any physical phenomenon, including DST or the Sun—Earth dipole angle, was found. However, these data do indicate that even during quiet times there are temporal changes in the geomagnetic field that cause the cutoff to fluctuate by 1 to 2°. (25 references) (auth)

51495 FLARE INDUCED SHOCKS AND COROTATING STREAMS IN THE INTERPLANETARY MEDIUM. Wiseman, M.; Dennison, P. A. (Univ. of Adelaide). Proc. Astron. Soc. Aust.; 2: No. 2, 79-82(Mar 1972).

The origin and development of geomagnetic storm sudden commencements and sudden increases were observed and recorded during June 1969 using a method for mapping the movement and geometry of large-scale features of the solar wind by observation of the interplanetary scintillation (IPS) of a grid of discrete radio sources. It is shown that both plasma blast waves and corotating streams can be primary agents in the onset of geomagnetic storms, and that IPS is a powerful method for investigating the structure of such phenomena. (Australia)

51496 SOLAR X-RAY SPECTRUM DEDUCED FROM A PROPORTIONAL COUNTER EXPERIMENT AND THE RESULTANT PRODUCTION OF IONIZATION IN THE MESOSPHERE. Lepine, D.; Hall, J. E. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 34: No. 9, 1507-23(Sep 1972).

The measurement of the 1 to 6 keV (2 to 12 Å) solar x-ray spectrum made by Petrel rocket on June 19, 1969 is described. The flight equipment consisted of a collimated, krypton-filled proportional counter, with a beryllium window, sensitive to photons in the range 1 to 10 keV. A 7-level pulse-height discriminator was employed to analyze the pulses produced by the counter and the output was telemetered to ground. To avoid the assumption of a constant temperature model for the source, a new iterative technique was developed to arrive at the spectrum. The incident spectrum was found from data obtained above 130 km, and data collected at lower heights was used to verify laboratory values of absorption coefficient. The production of ionization by x rays was calculated for the height range 65 to 90 km and a comparison with other published results is presented. (auth)

51497 POSSIBLE INTERSECTION OF A GEOMAGNETIC TRACE AT A DISTANCE OF 3000 EARTH RADII DURING THE FLIGHT OF THE MARS-3 AUTOMATIC INTERPLANETARY SPACE STATION. Vaisberg, O. L.; Bogdanov, A. V.; Borodin, N. V.; (and others) (Inst. of Cosmic Research, Moscow). Dokl. Akad. Nauk SSSR; 203: No. 2, 309-10(11 Mar 1972). (In Russian).

Apparatus aboard the Mars-3 space station, which ordinarily recorded the spectrum of the solar wind, recorded an energy spectrum of ions differing pronouncedly from that of the solar wind at the end of July 1971. A probable explanation was found in the intersection of Mars-3 with a geomagnetic trace at an antisolar point about 2×10^7 km from the earth. (K.S.W.)

51498 IDENTIFICATION OF TANGENTIAL DISCONTINUITIES IN THE SOLAR WIND. Ivanov, K. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 1, 114-17(1972).

Translated from Kosm. Issled.; 10: No. 1, 131-3(1972).

Observations made on Mariner 5 for July 20 and Aug. 30, 1967 were used to help determine the mode of discontinuities observed in the solar wind. Previously, tangential discontinuities were identified by a qualitative correlation between measurements of magnetic field, density, and temperature and conditions prevailing at the tangential discontinuity, or by a dependence of the transit time between points at which measurements were taken on the orientation of the front. The ineffectiveness of the methods is discussed. It is stated that the conditions prevailing at the discontinuities permit a single-valued unambiguous identification of tangential discontinuities and shock waves, even in the case where only simultaneous observations of the direction of the stream velocity v, of the magnetic field F, and of the concentration n are available, while information on plasma pressure is lacking. The identification is based on the conditions linking the discontinuities F, v, and n, and then the case of tangential discontinuities is continued. Properties of tangential discontinuities discussed are enumerated. (J.C.W.)

51499 DIFFUSION OF COSMIC RADIATION OF SOLAR ORIGIN THROUGH THE INTERPLANETARY MEDIUM. Kuzhevskii, B. M.; Zel`dovich, M. A. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 1, 126-7(1972).

Translated from Kosm. Issled.; 10: No. 1, 140-1(1972).

A corollary is investigated dealing with the diffusion of cosmic radiation of solar origin through interplanetary space. Previous investigations of proton propagation from solar flares demonstrated that, starting at a certain energy, the motion of protons is described by the diffusion model. The propagation of nuclei is heavier than protons, but the propagation is diffusional. Diffusion coefficients for protons and nuclei are given. The interplanetary medium performs as a spectrometer, dividing the nuclides in terms of arrival at a specified point in space. Heavier nuclides will overtake lighter ones, even though their velocities are equal. An investigation is given for two nuclides with the same energy per nucleon where the time t that it takes a particle to traverse a distance r is inversely proportional to the diffusion coefficient. If the intensity of protons and nuclides such that $Z \geq 2$ is measured at the same energy per nucleon, the arrival of the heavier nuclei will be recorded first, followed by the protons, and the value of $\Delta t = t_p - t_i$ (i is a nuclide) will be detectable experimentally, providing that measurements be taken at the instant that the particles first arrive from the solar flare. The present results do not depend on whether the source of solar cosmic rays is instantaneous. (J.C.W.)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 50204 and 52114.

51500 (LNF–72/53) (e, 2e) QUASI-FREE ELECTRON SCATTERING ON BOUND ELECTRON, COINCIDENCE MEASUREMENTS OF SCATTERED AND EMITTED ELECTRONS IN CARBON. Camilloni, R.; Guidoni, A. Giardini; Stefani, G.; Tiribelli, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 8 Jun 1972. 17p. Dep. NTIS (U. S. Sales Only).

Momentum distributions of bound electrons belonging to K and L shells in carbon were separately measured. Data obtained from the angular distribution of coincidences between the two electrons outcoming from a quasi-free (e,2e) process were compared with theoretical previsions. (auth)

Atomic and Molecular Properties

Refer also to abstracts 51286, 51525, 51535, 51553, 51589, 52119, and 52225.

51501 (ANL-7860(Pt.1), pp 32-6) ISOTOPE EFFECTS ON MOLECULAR IONIZATION YIELDS: SPECIAL CASE WHERE $\delta_H = \delta_D$ AND $\gamma_H = \gamma_D$. Person, J. C. 1971.

In Radiological Physics Division annual report, July 1970–June 1971.

A discussion is given of a special case of isotope effects on molecular ionization yields when a competitive preionization occurs together with direct ionization and noncompetitive neutral-product formation. The special case is when the yield of direct ionization, δ, and the yield of the noncompetitive neutral-product formation, γ, are both independent of isotopic substitution. Figures are presented to show the relations between the observed ionization yields and the fraction of ionization resulting from direct ionization. The additional uncertainty produced by the γ process is also depicted graphically. (auth)

51502 (LA–4944) EMISSION SPECTRUM OF URANIUM BETWEEN 19,080 AND 30,261 cm^{-1}. Steinhaus, David W.; Phillips, Marilyn V.; Moody, Jean B.; Radziemski, Leon J. Jr.; Fisher, Kay J.; Hahn, Dale R. (Los Alamos Scientific Lab., N. Mex.). Aug 1972. Contract W-7405-eng-36. 229p. Dep. NTIS.

Wave-number values for 39,659 lines of uranium between 19,080 and 30,261 cm^{-1} are listed along with their log relative intensity values, a line shape code, and an estimate of the wave-number accuracy. Also, when known, the classification of the line and its experimental assignment to U I or U II are given. The source used was a 99.75% ^{238}U hollow-cathode discharge tube with either neon or krypton carrier gas. The spectrographic resolution limit was better than 0.04 cm^{-1}, and the measurement accuracy for most lines was better than ± 0.005 cm^{-1}. The Los Alamos Scientific Laboratory's automatic comparator was used to find and measure each line on one to nine spectrograms. An additional computer program, which was used to prepare the final line list, is described. (auth)

51503 (LA-DC–72-369) PRECISE MEASUREMENTS OF DIATOMIC DISSOCIATION RATES IN SHOCK WAVES. Breshears, W. D.; Bird, P. F. (Los Alamos Scientific Lab., N. Mex.). 1972. 22p. (CONF-720811–1). Dep. NTIS.

From fourteenth international symposium on combustion; University Park, PA. (20 Aug 1972).

The dissociation of H_2 in mixtures of 5%, 10%, and 20% H_2 in Ar and Xe was studied behind incident shock waves over the temperature range 3500 to 8000°K. Dissociation rates were determined by measurement of postshock density gradients using a laser-beam deflection technique. The postshock density gradient profiles exhibit the same highly characteristic "dip" observed previously with O_2-rare gas mixtures (J. Chem. Phys. 55, 4017 (1971)), and the magnitude of the gradient at this point is again interpreted as a measure of the initial dissociation rate. The overall rate coefficients so obtained are of high precision, and the values determined for k_d^M, the coefficient due to H_2-M collisions are given. By numerical integration of the measured density gradient profile from the point of the initial rate measurement, the density, and thus the composition, temperature, and overall rate coefficient, were determined at subsequent points in the reaction course. From this data values of the hydrogen atom coefficient were obtained. Values for all the rate coefficients determined are in general agreement with previously reported values. More significantly, in contrast with the results of previous work, the data are of sufficient precision to provide strong support for the traditional assumptions concerning diatomic dissociation; i.e., the interpretation of the various k_d^M as true chemical rate "constants." (auth)

51504 ENERGY LEVELS OF DOUBLE IONIZATION STATES OF ATOMS OF PURE ELEMENTS. Blokhin, M. A.; Platkov, A. I. (Rostov State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 2, 325-33(Feb 1972). (In Russian).

Semi-empirical values for LL energy levels are tabulated for all elements from carbon to lawrencium, and may be useful in calculating Auger transitions. Auger spectral lines are employed in connection with a second table which lists LL, LM, LN, LO, MM, MN, MO, NN, NO, and OO energy levels for pure elements, including a number of transuranium elements. (K.S.W.)

51505 INFLUENCE OF THE BASIS SET ON THE DISPERSION ENERGY BETWEEN TWO HYDROGEN MOLECULES FROM A NONEMPIRICAL CALCULATION. Kochanski, E. (Institut de Chimie, Strasbourg). Chem. Phys. Lett.; 15: No. 2, 254-6(1 Aug 1972).

It is shown that in the rectangular configuration, it is necessary to introduce "p" polarization atomic orbitals with small exponent in order to provide a good description of the dispersion energy. The present values are very close to the available semi-empirical results. (auth)

51506 CHEMICAL SHIFTS IN URANIUM AUGER TRANSITIONS. Allen, G. C.; Wild, R. K. (Berkeley Nuclear Labs., Gloucestershire, Eng.). Chem. Phys. Lett.; 15: No. 2, 279-81 (1 Aug 1972).

Uranium metal and uranium dioxide surfaces were examined using Auger electron spectroscopy. An essentially oxide-free uranium surface can be produced by heating the metal to 800°C in a vacuum; subsequent oxidation is shown to produce chemical shifts in the uranium Auger peak positions. (auth)

51507 LIFETIME OF THE 2S STATE OF He^+. Prior, M. H. (Univ. of California, Berkeley). Phys. Rev. Lett.; 29: No. 10, 611-14(4 Sep 1972).

The lifetime of the 2S state of He^+ was measured by counting decay photons versus time from an ensemble of excited He^+ ions stored in an electromagnetic trap of the Penning type. The result is $\tau_{2S} = 1.922(82)$ ms. This is in agreement with the theoretical value of 1.899 ms. The agreement between theory and experiment implies a new upper limit on the amount of parity impurity in the 2S wave function. (auth)

51508 LIFETIME OF THE $2^2S_{1/2}$ STATE OF SINGLY IONIZED HELIUM. Kocher, C. A.; Clendenin, J. E.; Novick, R. (Columbia Univ., New York). Phys. Rev. Lett.; 29: No. 10, 615-18(4 Sep 1972).

The natural lifetime of the 2S state of He^+ was measured in a decay-in-flight experiment. The result, $\tau = 2.04^{+0.81}_{-0.34}$ ms, is consistent with the theory of two-photon spontaneous emission and determines an upper bound $\lambda \leq 8 \times 10^{-5}$ for the coupling constant of the pseudoscalar "anapole" interaction. (auth)

51509 TEMPERATURE DEPENDENCE OF THE POLARIZABILITY OF H_2 AND D_2 MOLECULES. Milenko, Yu. Ya.; Karnatsevich, L. V.; Kogan, V. S. (Physical-Technical Inst., Kharkov). Physica; 60: No. 1, 90-6(Jul 1972).

Polarizability values (α) of hydrogen and deuterium molecules were calculated at 20.4; 77.3°, 300°, and 400°K. The temperature dependence of an isotope effect in the polarizabilities of H_2 and D_2 was found to be practically absent, i.e., $[\alpha_{H_2}(T) - \alpha_{D_2}(T)]/\alpha_{H_2}(T) \approx$ const. The difference in polarizabilities of the ortho–para modifications of both isotopes at these temperatures was calculated. For calculation of the polarizability in the jth rotational state both the relation $\alpha(r)$ (where r is the distance between the nuclei) and the nuclear wave functions for the adiabatic Morse potential with corrected parameters were used. (auth)

51510 HIGHLY EXCITED ELECTRONIC LEVELS OF THE H_2 MOLECULE IN ASTROPHYSICS. Zel'dovich, Ya. B.; Ruzmaikina, T. V. (Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 5, 198-200(5 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 5, 283-5(5 Mar 1972).

Attention is directed to highly excited H_2 molecules in which the transitions between close electronic levels fall in the radio band. An idea by Kardashev (1959), that it is possible to observe, under astrophysical conditions, radio lines of atomic hydrogen with a tremendous number of levels, is developed. (W.D.M.)

51511 POSSIBILITY TO DETERMINE WEAK HYPERFINE STRUCTURE INTERACTION CONSTANTS BY MAGNETIC DEPOLARIZATION. Stoeckel, F.; Lombardi, M.; Pebay-Peyroula, J. C. (Univ., Grenoble, France. Domaine Univ., St. Martin d'Heres, France). Phys. Lett.; 40A: No. 2, 151-2(3 Jul 1972).

A new method to measure weak hyperfine structure interaction constants ($a\tau \leq 1$) by magnetic depolarization, involving interaction between nuclear orientation and electronic alignment, was used on the 3 $^1P_1$ level of ^3He. It was found that $a/\Gamma = 0.075 \pm 0.010$. (auth)

51512 ANALYTIC TREATMENT OF THE COULOMB POTENTIAL IN THE PATH INTEGRAL FORMALISM BY EXACT SUMMATION OF A PERTURBATION EXPANSION. Goovaerts, M. J.; Devreese, J. T. (Univ. of Antwerp, Middelheimlaan, Belgium). J. Math. Phys. (N. Y.); 13: No. 7, 1070-82(Jul 1972).

A straightforward analytical calculation of the s-like energy spectrum of the hydrogen atom is performed entirely within Feynman's path integral formalism. For this purpose the integral transform $W = \int d^3r_\beta K(r_\beta,0)$, where $K(r_\beta,0)$ is the density matrix of the hydrogen atom written as a path integral, is calculated by means of the exact summation of a "modified" perturbation expansion (W is expanded as a power series in $\sqrt{\beta}$ with $\beta = 1/k\,T$). Performing this summation is equivalent to solving a problem of moments with infinite moments. For a wide class of potentials the perturbation expansion for W converges faster than the power-series expansion for the exponential function (for the Coulomb potential the convergence rate of both expansions is the same). It is shown how the complete energy spectrum can be obtained by this method. It is also illustrated how the wave functions might be obtained by transforming W. (auth)

51513 CORRESPONDENCE OF FUNDAMENTAL AND COMBINATION BANDS IN THE INFRARED SPECTRA OF LIQUID H_2O AND D_2O. Bonner, O. D. (Univ. of South Carolina, Columbia). Infrared Phys.; 12: No. 2, 109-14(Jun 1972).

The frequencies of the fundamental ν_1, ν_2, and ν_3 bands for unbonded liquid H_2O and D_2O were calculated from the frequencies observed for the combination bands in the near-infrared region. The positions of the centers of the broad bands due to the hydrogen-bonded species were also estimated. All calculated values were compared with the observed spectra of liquid H_2O and D_2O. It is concluded that the ν_2 bands observed at 1645 cm^{-1} for H_2O and 1210 to 1215 cm^{-1} for D_2O are due to the "monomeric" species. This is confirmed by the temperature dependence of these bands. (auth)

51514 MEASUREMENT OF THE RATE COEFFICIENT FOR THE RECOMBINATION OF He^+ WITH ELECTRONS. Collins, C. B.; Hicks, H. S.; Wells, W. E.; Burton, R. (Univ. of Texas, Dallas). Phys. Rev., A; 6: No. 4, 1545-58(Oct 1972).

A computer-linked spectroscopic system with a high-sensitivity-resolution product was used to measure the time-dependent net rate of production of neutral helium atoms resulting from the recombination of He^+ with electrons in a pulsed helium afterglow at neutral pressures of 1.86 and 44.6 torr. The recombination-rate coefficient of He^+ as a function of afterglow time was obtained by dividing these data by the product of the electron and atomic-ion density as determined from intensity measurements of radiation from bound levels in Saha equilibrium with the free electrons. Simultaneous time-resolved measurement of the electron density with a 35-GHz Fabry–Perot resonator gave the recombination-rate coefficient as a continuous function of electron densities without the need of a priori assumptions about that functional form. The electron temperature as a function of electron density in the recombining afterglow was determined from analyses of time-resolved measurements of the intensity distribution of radiation from the continuum states above the $n^3P \rightarrow 2^3S$ Rydberg series in atomic helium. For pressures below a nominal 2 torr, the resulting parametrization of the recombination-rate coefficient for He^+ with electrons can be represented as $\alpha = 7.1 \times 10^{-20}(T/300)^{-4.3}[e]$ cm^3/s, where T is the electron temperature and [e] the electron density. At higher pressures the rate coefficient is found to decrease as a consequence of associative ionization of the excited states. (auth)

51515 NONRELATIVISTIC FLUORESCENCE YIELDS FOR THE 3p AND THE 3d SHELLS. Bhalla, C. P. (Kansas State Univ., Manhattan). Phys. Rev., A; 6: No. 4, 1409-13(Oct 1972).

The Auger group rates and fluorescence yields are presented for Z = 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 83, and 85 for a vacancy in either the 3p shell or the 3d shell. The present calculations were performed with the nonrelativistic Hartree–Fock–Slater model with the exchange approximation of Herman, Van Dyke, and Ortenburger. The theoretical fluorescence yields can be used in converting the experimental M-shell x-ray production cross sections by protons and α particles to the cross section for M-shell vacancy production. (auth)

51516 SYSTEMATIC TRENDS IN ATOMIC OSCILLATOR STRENGTHS: THE HELIUM ISOELECTRONIC SEQUENCE. Cohen, M.; McEachran, R. P. (Hebrew Univ., Jerusalem). Can. J. Phys.; 50: No. 12, 1363-9(15 Jun 1972).

Electric dipole oscillator strengths (f values) were calculated for a large number of singlet and triplet S–P, P–D, and D–F transitions in the helium isoelectronic sequence through O^{+6}. The analytical orbital wave functions employed were of the frozen-core type; they generally produce very good agreement between length and velocity values of the calculated oscillator strengths. A conspicuous exception occurs in many cases where the principal quantum number remains unchanged in the transition, and the more reliable dipole length values were adopted for such transitions. The smooth variation of the calculated f values as functions of the inverse of the nuclear charge Z provided a sensitive check on the accuracy of the computations and indicated a considerable number of P–D transitions where the velocity values seemed the more reliable. Wherever comparison data are available, calculated oscillator strengths are in excellent agreement with the most accurate values; in other cases, the absolute uncertainty in the f values should in no case exceed 5%. (auth)

51517 "FREE-FALL" SOLUTION OF THE KEPLER PROBLEM IN THE PRESENCE OF THE MAGNETIC MOMENT. Gryzinski, M. (Inst. for Nuclear Research, Swierk, Poland). Phys. Lett.; 41A: No. 1, 69-70(28 Aug 1972).

The zero-angular-momentum solution of the Kepler problem for the electron carrying a magnetic moment is considered, and some aspects concerning the model representation of the hydrogen atom are discussed. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

51518 MODEL OF A POSITRONIUM MOLECULE. Hill, C. Trecia (Oklahoma State Univ., Stillwater). Nuovo Cim.; 10B: No. 2, 511-17(11 Aug 1972).

A model of a positronium molecule is proposed wherein each positronium atom acts like an electric dipole, with an attractive interaction between dipoles. The binding energy of this molecule has been estimated to be 0.055 eV with a lifetime of about 10^{-15}s. (auth)

51519 PICK-OFF QUENCHING OF ORTHO-POSITRONIUM IN BINARY LIQUID MIXTURES. Levay, B.; Hautojaervi, P. (Helsinki Univ. of Tech., Otaniemi, Finland). Radiochem. Radioanal. Lett.; 10: No. 6, 309-14(15 Jul 1972).

The pick-off quenching rate of the ortho-positronium was found to be additive in dioxane–water mixtures, but in methanol–water mixtures a significant deviation from the additivity was observed. It is concluded that the structural properties of the mixtures and the change of the free volume available for positronium are responsible for the deviations. (auth)

51520 QUASIPOTENTIAL APPROACH TO THE CALCULATION OF THE ONE-PHOTON EXCHANGE DIAGRAMS BY MEANS OF THE POLARIZATION OPERATOR. Nyun'ko, N. E.; Tyukhtyaev, Yu. N. (Saratov State Univ., USSR). Teor. Mat. Fiz.; 12: No. 1, 56-63(Jul 1972). (In Russian).

Using the expression for the polarization operator obtained with the aid of the quasi-potential equation, the contribution to the hyperfine shift of the ground level of positronium is calculated up to the terms proportional to α^6. (auth)

51521 CROSS SECTIONS FOR ELASTIC SCATTERING OF SLOW POSITRONS IN INERT GASES. Levin, B. M. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Eng. Transl.); 15: No. 12, 514-16(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 12, 727-30(20 Jun 1972).

Measurements were made of the reduction in the shoulder in the time spectra of positron annihilation in Xe and Ar following addition of lighter inert gases. The shoulder is related to the elastic slowing down. The obtained positron elastic scattering cross sections agree with available data for He, Ne, and Ar. The average cross section for Xe is estimated to be $6\pi a_0^2$ at energies 1 to 5 eV. (D.L.C.)

51522 MEASUREMENT OF THE RATE λ_e FOR THE REACTION $\mu p + d \rightarrow \mu d + p$ AT ROOM TEMPERATURE. Bertin, A. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Bruno, M.; Placci, A.; Zavattini, E. Lett. Nuovo Cim.; 4: No. 11, 449-53(15 Jul 1972).

The transfer rate λ_e of a negative muon from a proton to a deuteron, according to the process $\mu p + d \rightarrow \mu d + p + 135$ eV, was measured at the muon channel of the 600 MeV CERN synchrotron, by slowing-down negative muons in a gaseous target of ultrapure hydrogen, contaminated by small amounts of deuterium and xenon. The value of λ_e, determined by fitting the experimental time distribution of the muon decay electrons to the theoretical yield, was found to $(0.84 \pm 0.13) \cdot 10^{10}$ S^{-1}. (L.B.S.)

51523 TWO-FREQUENCY PRECESSION OF MUONIUM IN STRONG MAGNETIC FIELDS. Gurevich, I. I.; Nikol'skii, B. A.; Selivanov, V. I.; Kurchatov, I. V. JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 453-5(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 640-3(5 Jun 1972).

The changes of the polarization of the μ^+ meson of muonium in a strong transverse magnetic field is studied. The frequencies of the eigenstates of the muonium atom are plotted versus the magnetic field B. Two-frequency precession is shown to occur not only in the $B \ll B_0$ region, but also in the $B \gg B_0$ region. It is shown that an experimental determination of the frequency ω_0 using two-frequency precession is possible. (D.L.C.)

Collision Phenomena

Refer also to abstracts 51181, 51514, and 52211.

51524 (AD—739184) CROSS SECTIONS FOR EMISSION OF LYMAN-ALPHA RADIATION IN COLLISIONS OF 1 TO 25-keV PROTONS AND HYDROGEN ATOMS WITH CONSTITUENTS OF PLANETARY ATMOSPHERES. Report for July—November 1971. Birely, John H.; McNeal, Robert J. (Aerospace Corp., El Segundo, Calif.). 31 Jan 1972. Contract F04701-71-C-0172. 23p. (SAMSO-TR—72-36). NTIS.

Cross sections are reported for emission of Lyman-alpha radiation in collisions of a charge-equilibrated 1- to 25-keV hydrogen beam with N_2, O_2, CO_2, NH_3, CH_4, and H_2. For each target molecule, the separate cross sections for formation of H (2p) and H (2s) in H^+ and H collisions and the fractional population of these projectiles in a charge-equilibrated beam are used to calculate the effective cross section for formation of H (2p) and H (2s). Individual contributions to the overall Lyman-alpha intensity owing to projectile and dissociative excitation are presented for the hydrogen-containing compounds. The results show that, for both projectile and dissociative excitation, collisions involving impact of fast hydrogen atoms rather than protons are the major source of Lyman-alpha production in an aurora. Projectile excitation is demonstrated to be a substantially more important source of Lyman alpha than dissociative excitation in the 1- to 25-keV energy range. (auth) (NTIS)

51525 (COO—2100-3) TECHNICAL PROGRESS REPORT, APRIL 1, 1971—JULY 31, 1972. Platzman, Robert L. (Chicago Univ., Ill.). 1972. Contract AT(11-1)-2100. 6p. Dep. NTIS.

Work during the period on the following areas related to primary action of ionizing radiation is summarized briefly: calculation of oscillator-strength distributions for Ar and H_2, analysis of primary ionization processes in hydrogen, calculation of inelastic cross sections for electron impact on argon and hydrogen, calculation of complete degradation spectra and sub-excitation-electron spectra for the total absorption in He of monoenergetic electrons having various initial kinetic energies up to 10 keV. No detailed results are included. (A.G.W.)

51526 (FRNC-R—8) CENTER OF ATOMIC PHYSICS DURING 1971. Blanc, Daniel (Toulouse Univ. (France)). [nd]. 74p. (In French). Dep. NTIS (U. S. Sales Only).

This report concerns courses given at the Center of Atomic Physics and the work effected during 1971 by the research group of the atomic physics section (atomic collisions; afterglow in gases irradiated with ionizing particles; continuous current discharges in gases at medium and high pressures; electric arcs; the physics of dielectrics; transfer of radiations in matter; stimulated electron emission; p-n semiconductor junctions) and the group concerned with the physics of aerosols and atmospheric exchanges (physicochemical study of atmospheric aerosols; aerosols in uranium mines; atmospheric exchanges). A list of the research workers, publications, theses, and papers presented at congresses (together with brief summaries) is presented. (France)

51527 (ORNL-TM—3904) THRESHOLD-ELECTRON EXCITATION AND COMPOUND NEGATIVE ION FORMATION IN POLYATOMIC MOLECULES. Pisanias, M. N.; Christophorou, L. G.; Carter, J. G. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 145p. Dep. NTIS.

Thesis submitted by M. N. Pisanias to Univ. of Tennessee, Knoxville.

The threshold-electron excitation (TEE) of key polyatomic molecules was studied with a newly constructed electron spectrometer. Experimental data were obtained on the diazabenzenes pyridazine, pyrimidine, and pyrazine; naphthalene and the monoazanaphthalenes quinoline and isoquinoline; and the first two n-alkanes methane and ethane. These are presented, discussed, and compared with photoabsorption spectra and, whenever possible, compared with high-energy electron-impact spectral data. The lowest-lying electronic state due to an optically forbidden $n \rightarrow \pi^*$ transition was observed in pyridazine, pyrazine, quinoline, and isoquinoline. The TEE spectra of the diazabenzenes and monoazanaphthalenes extend below the first excited electronic state and show the existence of a double compound-negative-ion resonance state in these molecules. A simple theoretical treatment is provided explaining these double compound-negative-ion resonance states in the diazabenzenes. The TEE spectra of methane and ethane show the existence of one compound negative resonance state below the first excited electronic state and the excitation of states due to optically forbidden transitions. The importance of the present findings is stressed, and their implications in the study of polyatomic structures of biological interest are indicated. (auth)

51528 INTERPOLATION FORMULAE FOR THE ELECTRON IMPACT EXCITATION OF IONS IN THE H, He, Li, AND Ne SEQUENCES. Mewe, R. (Space Research Lab., Utrecht). Astron. Astrophys.; 20: No. 2, 215-21(1 Sep 1972).

The cross sections for electron impact excitation from the ground state of H-, He-, Li-, and Ne-like ions are approximated by interpolation formulas with four parameters that can be integrated analytically over a Maxwellian electron velocity distribution to give the corresponding rate coefficients. The formulas are fitted to the available theoretical and observational data about excitation cross sections and rate coefficients. (77 references) (auth)

51529 EXPERIMENTAL RATE CONSTANT FOR $H + H_2$ $(\nu'' = 1) \rightarrow H + H_2$ $(\nu'' = 0)$. Heidner III, R. F.; Kasper, Jerome V. V. (Univ. of California, Los Angeles). Chem. Phys. Lett.; 15: No. 2, 179-84(1 Aug 1972).

A rate constant for the process $H + H_2(\nu'' = 1) \rightarrow H + H_2(\nu'' = 0)$ was measured and compared to theory. The concentration of $H_2(\nu'' = 1)$ and H downstream from a microwave discharge in pure H_2 were determined by quantitative vacuum-ultraviolet spectroscopy and isothermal calorimetry, respectively. (auth)

51530 EFFECT OF THERMAL ENERGY ON IONIZATION EFFICIENCY CURVES OF NEGATIVE IONS FROM SF_6. Lifshitz, Chava; Weiss, Matanya (Hebrew Univ. of Jerusalem). Chem. Phys. Lett.; 15: No. 2, 266-8(1 Aug 1972).

The ionization efficiency curves for SF_6^-, SF_5^-, and the "metastable" ion $SF_6^- \rightarrow SF_5^-$ were determined experimentally at 395°K and at 255°K. Calculated "breakdown graphs" for SF_6^- at these two temperatures are in excellent agreement with experiment, for an assumed activation energy of 0.39 ± 0.04 eV for the reaction $e + SF_6 \rightarrow SF_5^- + F$. (auth)

51531 FEASIBILITY OF THE EXPERIMENTAL DETECTION OF LONG-RANGE RETARDED DIPOLE FORCES. Powers, T. R.; Cross, R. J. Jr. (Yale Univ., New Haven). Chem. Phys. Lett.; 15: No. 2, 293-5(1 Aug 1972).

The effect of the long-range retarded dipole forces on the total elastic cross section for atom—atom scattering was calculated using the recently published potential of O'Carrol and Sucher and the Landau—Lifschitz approximation; it was found to be less than 0.5%. For He—He scattering at very low energies, differences of a few percent exist in the region of the Ramsauer—Townsend minimum in the cross-section-versus-energy curve. (auth)

51532 ABSOLUTE TOTAL CROSS SECTIONS FOR SCATTERING OF HYDROGEN ATOMS BY ARGON, KRYPTON, AND XENON. Aquilanti, V.; Liuti, G.; Vecchio-Cattivi, F.; Volpi, G. G. (Univ., Perugia, Italy). Chem, Phys. Lett.; 15: No. 2, 305-8(1 Aug 1972).

Absolute total cross sections for scattering of hydrogen atoms by argon, krypton, and xenon were measured as a function of velocity in the range from 1.8 to 6.2 km/s. An analysis in terms of Lennard-Jones (12,6) and (8,6) model potentials leads to estimates of the interatomic forces. (auth)

51533 SLOW COLLISIONS IN THE THREE-BODY SYSTEM WITH COULOMB INTERACTION. THE FORMULATION OF THE METHOD. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 12: No. 1, 64-77(Jul 1972). (In Russian).

The general approach to the problems of slow collisions in the three-body system with Coulomb interaction is formulated. To this end the method of perturbed stationary states is used, i.e., the expansion of solutions of the Schrödinger equations of the three-body problem over the eigenfunctions of the quantum-mechanical two-center problem. The phase function method is used for the numerical integration of the arising equations. The method suggested makes possible the correct statement and solution of a large class of the atomic and mesoatomic physics problems. (auth)

51534 SUPERELASTIC COLLISIONS OF VIBRATIONALLY EXCITED H_2^+ WITH ATOMS AND MOLECULES. Herrero, F. A.; Doering, J. P. (Johns Hopkins Univ., Baltimore). Phys. Rev. Lett.; 29: No. 10, 609-11(4 Sep 1972).

The direct experimental observation of superelastic collisions of vibrationally excited H_2^+ ions with atomic and molecular targets is reported. Energy-change spectra taken with H_2^+ incident on He, Ne, Ar, Kr, and H_2 targets show a strong dependence of the cross section on the atomic number of the target. The cross sections for superelastic collisions were observed throughout the kinetic-energy range 100 to 1500 eV; they appear to be largest in the region 100 to 500 eV, decreasing slowly at higher energies. (auth)

51535 COINCIDENCE MEASUREMENT OF QUASIFREE SCATTERING OF 9-keV ELECTRONS ON K AND L SHELLS OF CARBON. Camilloni, R. (Laboratori Nazionali del Comitato Nazionale per l'Energia Nucleare, Frascati, Italy); Guidoni, A. Giardini; Tiribelli, R.; Stefani, G. Phys. Rev. Lett.; 29: No. 10, 618-21(4 Sep 1972).

Momentum distributions of electrons bound in the K and L shells of carbon were separately measured. Data obtained from the angular distribution of coincidences between the two electrons outcoming in a quasi-free (e,2e) process are compared with theoretical predictions. (auth)

51536 DOUBLE IONIZATION OF MAGNESIUM BY THERMAL COLLISIONS WITH HELIUM IONS. Latush, E. L.; Sem, M. F. (Rostov State Univ.). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 457-9(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 645-8(5 Jun 1972).

The afterglow of a pulsed gas discharge in a He–Mg mixture is observed. The afterglow in all Mg II lines consists of a short flash followed by a prolonged, intense decaying component. Addition of Ar does not affect the afterglow shape. Increasing the Mg vapor pressure decreases the duration of the afterglow. The afterglow is of the recombination type. The reaction kinetics of the reaction $He^+ + Mg \rightarrow He + Mg^{2+} + e$ are discussed, and the cross section of this reaction is determined to be $(1.6 \pm 0.5) \times 10^{-15}$ cm². Coherent laser action is observed in the Mg II 9244 and 9218 Å lines, lagging the current pulse by 30 to 50 μsec. (D.L.C.)

51537 ELECTRONIC AND IONIC IMPACT PHENOMENA. VOLUME III. SLOW COLLISIONS OF HEAVY PARTICLES. Massey, H. S. W. International Series of Monographs on Physics. Oxford; Clarendon Press (1971). 959p. pound 12.

The subject is considered under the following chapters: collisions between atoms and molecules under gas-kinetic conditions—elastic collisions; collisions between atoms and molecules under gas-kinetic conditions—collisions involving excitations of vibration and rotation—reactive collisions between molecular beams; collisions between atoms (and/or molecules) under gas-kinetic conditions—collisions involving electronic transitions; and collisions under gas-kinetic conditions—ionic mobilities and ionic reactions. (UK)

51538 DOUBLE EXCITATION OF ATOMS BY ELECTRON IMPACT. Kulander, Kenneth C.; Dahler, John S. (Univ. of Minnesota, Minneapolis). Phys. Rev., A; 6: No. 4, 1436-51(Oct 1972).

The electron-impact double-excitation cross sections for several states of lithium, beryllium, magnesium, and calcium are calculated using the Born–Oppenheimer scattering approximation. The energy dependence of the total cross sections and the angular dependence of the differential cross sections for these parity-unfavored transitions are reported. The maximum values of the total cross sections for excitation of the lowest states $(np)^{2\,3}P_g$ of beryllium, magnesium, and calcium are found to be comparable in magnitude to those for single excitations in the same energy range $(\sim\pi a_0^2)$. Those for the $(np)(3d)\,^1D_u$ and ^3D_u excitations are found to be of the order of $10^{-1}\ \pi a_0^2$ for magnesium and $10^{-2}\ \pi a_0^2$ for beryllium. The highly excited $(1s)(2p)^{2\,4}P_g$ state of lithium has a maximum cross section of $4 \times 10^{-5}\ \pi a_0^2$. The highly excited $(1s)(2p)^{2\,4}P_g$ for all these transitions are proportional to $\sin^2\theta$ and so they vanish in the forward and backward directions. The polarization of the dipole radiation emitted by these doubly excited states is described. Target wave functions are constructed using the Hartree–Fock method. For the $^1S_g \rightarrow {}^3P_g$ transition in magnesium and calcium, pseudopotential methods were also used to construct the target wave functions. The resulting cross sections agree closely with those computed with Hartree–Fock orbitals. (auth)

51539 GLAUBER CROSS SECTIONS FOR EXCITATION OF THE 2^1S STATE OF HELIUM BY ELECTRON IMPACT. Yates, A. C.; Tenney, A. (Indiana Univ., Bloomington). Phys. Rev., A; 6: No. 4, 1451-6(Oct 1972).

The Glauber amplitude for describing collisions of charged particles with two-electron atoms, resulting in transitions between spherically symmetrical states, is reduced to a readily computable form. Application is then made to the $2^1S \leftarrow 1^1S$ transition in helium, for which angular distributions are determined for 26.5-, 34-, 50-, and 83-eV incident electrons. Comparison with experiment shows that the Glauber theory is capable of accurately predicting the angular distributions for even this lowest-energy calculation. In particular the theory predicts the recently observed structure in the differential cross section. The energy dependence of the "apparent" generalized oscillator strength is also demonstrated for incident energies in the range 300 to 1100 eV. (auth)

51540 THEORY OF SMALL-ENERGY-TRANSFER COLLISIONS IN DOMINANT LONG-RANGED FORCES: H^+–H_2 AND e^-–H_2 VIBRATIONAL EXCITATION. Ritchie, Burke (Univ. of Alabama, University). Phys. Rev., A; 6: No. 4, 1456-60(Oct 1972).

In the two-state approximation analytic formulas are derived for the inelastic cross section in the limit in which the particle velocity is large relative to the energy defect. These formulas involve a mixing parameter and two eigenphase shifts. For scattering in a $C(X)/R^n$ potential, where X is an internal coordinate of the target, the integral cross section is presented in closed form, with parameters given by the elastic–superelastic potential-difference strength, the coupling strength, the velocity, and a cutoff for the singular potential, taken to be the target radius. Results are given for H^+-H_2, e^--H_2, and e^--N_2 vibrational excitation. The theory appears to be correct for the high-energy tail of the cross sections. (auth)

51541 ABSOLUTE EXPERIMENTAL CROSS SECTIONS FOR THE IONIZATION OF SINGLY CHARGED BARIUM IONS BY ELECTRON IMPACT. Feeney, R. K.; Hooper, J. W.; Elford, M. T. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 6: No. 4, 1469-78(Oct 1972).

The absolute cross sections for the single ionization of Ba^+ ions by electron impact were measured as a function of incident electron energy over the electron energy range from below threshold (10.001 eV) to approximately 1000 eV. It is found that the cross section increases from 1.94×10^{-16} to 3.76×10^{-16} cm² between 15.1 and 18 eV actual incident electron energy. This rapid rise is interpreted as the onset of autoionization. Some indication of structure occurring near the peak of the cross-section curve such as found in the isoelectronic system Cs is observed, but the relative magnitude of the apparent structure is of the same order as the 90% random-error confidence limits and thus cannot conclusively be regarded as being present. The maximum total error in the measurements is estimated to have its greatest value of less than ±20% at 15.5 eV while ±12% is typical of other energies. Of the total error, ±7% is deemed to be systematic. At incident electron energies below threshold, the cross section is found to be zero within 1% of the cross section at 48 eV. The measurements were performed in an all-metal ultrahigh-vacuum crossed-beam facility in which the nominal operating pressure was less than 5×10^{-9} torr. The ion source was a water-cooled surface-ionization-type ion source and the electron source was a modified 6L6GC beam power tube. Continuous-beam techniques were used for the majority of the measurements, but modulated-beam methods were employed as a check. Measurements made by the two techniques agreed to well within the allowable experimental error and showed no systematic variations. Numerous consistency checks were performed to evaluate possible sources of experimental error such as pressure modulation of the background gas, focusing of the ion beam by the electron beam, and errors in the beam-profile determination. The present Ba^+ ionization data are compared with the existing experimental and theoretical results. (auth)

51542 TEMPERATURE DEPENDENCE OF THE ELECTRON RUBIDIUM SPIN-EXCHANGE CROSS SECTION. Davis, S. J.;

Balling, L. C. (Univ. of New Hampshire, Durham). Phys. Rev., A; 6: No. 4, 1479-85(Oct 1972).

A spin-exchange optical-pumping experiment to study the temperature dependence of the electron—rubidium spin-exchange cross section is reported. In this experiment, electrons were polarized in a weak magnetic field by spin-exchange collisions with optically pumped Rb atoms. The electron—Rb collisions were the principal source of the electron-spin-resonance linewidth, and they also produced a shift in the resonance frequency. The magnitudes of the linewidth and frequency shift are functions of the electron—Rb scattering phase shifts. The electron linewidth at fixed Rb density was essentially constant over the temperature range 200 to 840°K indicating the spin-exchange cross section is well approximated by a $1/\nu$ velocity dependence. The ratio of the frequency shift to linewidth was 0.075 ± 0.005 at 300°K with an estimated Rb polarization of (20 ± 10)%, and the ratio was 0.027 ± 0.007 at 600°K with a Rb polarization of (10 ± 5)%. (auth)

51543 CHARGE-CHANGING CROSS SECTIONS OF 5- TO 25-MeV IODINE IONS IN HYDROGEN AND OXYGEN. Betz, Hans D. (Massachusetts Inst. of Tech., Cambridge); Wittkower, A. B. Phys. Rev., A; 6: No. 4, 1485-93(Oct 1972).

Iodine ions, accelerated to energies between 5 and 25 MeV, were passed through thin targets of hydrogen and oxygen, and nonequilibrium charge-state distributions were measured in order to obtain charge-changing cross sections. Results of cross sections for capture of one and two electrons and for loss of one to eight electrons are presented for ions with initial charge states ranging from 2^+ to 18^+. Multiple-electron loss of iodine ions was found to be relatively large in oxygen, but small in hydrogen. This systematic difference reveals the influence of different excitation mechanisms in energetic ion—atom collisions. The dependence of the cross sections on initial charge and velocity of the ions is discussed and, whenever possible, compared with theoretical expectations. (auth)

51544 THEORY OF LOW-ENERGY SCATTERING BY A LONG-RANGE r^{-8} POTENTIAL. Ganas, P. S. (California State Coll., Los Angeles). Phys. Rev., A; 6: No. 4, 1493-7(Oct 1972).

The low-energy scattering by a potential consisting of a long- and a short-range part is discussed. A general expression for the phase shift δ_L is derived starting from the radial Schrödinger equation. Effective-range expansions are presented for partial waves of all orders for the case of a long-range r^{-3} potential. The quantity $\tan\delta_L$ is calculated up to and including the term $k^{2L+7}\ln k$. It is found that in the low-energy limit, $\tan\delta_L$ is proportional to k^{2L+1} for s, p, and d waves, and $\tan\delta_L$ is proportional to k^6 for all the higher partial waves. (auth)

51545 ABSOLUTE CROSS SECTIONS FOR EXCITATION OF NEON BY IMPACT OF 20- TO 180-keV H^+, H_2^+, AND He^+. York, G. W. Jr.; Park, J. T.; Pol, V.; Crandall, D. H. (Univ. of Missouri, Rolla). Phys. Rev., A; 6: No. 4, 1497-1507(Oct 1972).

The technique of heavy-ion energy-loss spectrometry was used to measure excitation cross sections for the $(2p^5)3s$ and $(2p^5)3p$ electronic configurations of neon by impact of heavy ions upon ground-state neon. The incident particles used were H^+, H_2^+, and He^+ at impact energies from 20 to 180 keV. The results are compared with previous optical measurements of the emission cross sections of lines from these levels as excited by H^+ and He^+ impact. Agreement is not good, neither in shape nor in absolute magnitude, for excitation of the $(2p^5)3s$ configuration. However, agreement is surprisingly good for excitation of the $(2p^5)3p$ configuration. A curve-fitting technique was applied to extract relative singlet—triplet cross sections for levels within the $(2p^5)3s$ configuration. Almost no triplet excitation is observed for H^+ and H_2^+ impact. Significant triplet excitation is observed only for He^+ impact. (auth)

51546 IONIZATION CROSS SECTIONS OF GASEOUS ATOMS AND MOLECULES FOR HIGH-ENERGY ELECTRONS AND POSITRONS. Rieke, Foster F.; Prepejchal, William (Argonne National Lab., Ill.). Phys. Rev., A; 6: No. 4, 1507-19(Oct 1972).

Ionization cross sections of forty gases were measured for electrons of kinetic energies 0.1 to 2.7 MeV. The measurements are absolute, and extensive precautions were taken to minimize systematic and accidental errors. The energy dependence of the measured cross sections is accurately described by the Bethe asymptotic formula involving two parameters that represent important atomic properties. Comparisons were made between H_2 and D_2 and between CH_4 and CD_4; the observed differences are of the order of 1% and too small to be resolved with certainty. A close comparison was made between positrons and electrons in Ar at 0.67 and 1.1 MeV; the cross sections are observed to be equal within a probable error of 0.5%. (auth)

51547 CHARGE-CHANGING COLLISIONS BY 20- TO 120-keV H(2s)-ATOM IMPACT ON N_2, Ar, AND He. Hughes, R. H.; Choe, S. S. (Univ. of Arkansas, Fayetteville). Phys. Rev., A; 6: No. 4, 1413-18(Oct 1972).

Absolute cross sections were measured for the reaction $H(2s) + T \rightarrow H^+ + T + e$, where T represents N_2, Ar, and He. The measurements were carried out for impact energies in the 20- to 120-keV range. The experimental results for impact on He and N_2 are in general agreement with calculations based on the method of Bates and Walker. The calculation for impact on Ar overestimates the experimental stripping at the lowest energies but approaches satisfactory agreement at the highest energies. A few cross sections are presented for electron capture into the stable H^- state for H(2s) impact on these gases. The capture cross sections are small and are about 7% of the total capture cross sections by protons having the same energy. (auth)

51548 ANGULAR DISTRIBUTION OF METASTABLE HYDROGEN FORMED BY DISSOCIATION OF H_2^+. Sauers, I.; Fitzwilson, R. L.; Ford, J. C.; Thomas, E. W. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 6: No. 4, 1418-24(Oct 1972).

A study was made of H_2^+ dissociation by impact on targets of He, Ar, H_2, and N_2. Cross sections were measured for the angular distributions of metastable hydrogen, protons, and neutral hydrogen atoms resulting from dissociation. Projectile energies were in the range 4 to 12 keV; the angular range of the measurements extended from 0.5° to 5.0°. The angular distributions of metastables are consistent with their formation through excitation of the H_2^+ projectile into the $2s\sigma_g$ and $3p\sigma_u$ repulsive states of H_2^+. In all cases the dissociation cross section appears to be strongly peaked towards small angles between the internuclear axis of the molecule and the direction of the H_2^+ projectile; in the case of H(2s) formed by dissociation on He, the cross section appears to vary as approximately the square of the cosine of that angle. Angular distributions vary quite markedly from one target to another. (auth)

51549 CAPTURE AND LOSS OF ELECTRONS BY FAST NITROGEN AND OXYGEN ATOMS AND IONS IN AIR, NITROGEN, AND OXYGEN. Solov'ev, E. S.; Il'in, R. N.; Oparin, V. A.; Serenkov, I. T.; Fedorenko, N. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 267-70(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 336-9(Feb 1972).

Cross sections were measured for electron capture by N^+ and O^+ ions (σ_{10}), for the loss of one and two electrons by N and O atoms (σ_{01}, σ_{02}), and for the loss of an electron by N^+ and O^+ ions (σ_{12}) in air and oxygen in the energy range 28 to 180 keV. Other experimental data on these cross sections for energies from 800 eV to 3.5 MeV are summarized. Theoretical and experimental values of the cross section for the loss of an electron by a fast atom are compared. It is established that the cross section for nonresonant charge exchange with a small resonance defect behaves like the resonant charge-exchange cross section in the velocity range above the maximum in the cross section. (auth)

51550 ELECTRON CAPTURE INTO THE n = 3,4 STATES OF H BY LOW-ENERGY H^+, H_2^+ IMPACT ON HYDROGEN GAS. Hess, W. R. (CEN, Grenoble, France). Phys. Lett.; 41A: No. 1, 66-8 (28 Aug 1972).

Absolute cross sections for electron capture into the n = 3 and 4 states of H were measured for 0.3- to 3.0-keV H^+ and H_2^+ impact on hydrogen gas. The Balmer-α and -β cross sections decrease exponentially with decreasing impact energy according to an $\sigma = A\exp[-B|\Delta E|/\nu_+]$ relationship, where $|\Delta E|$ is the internal energy of the reaction and ν_+ the ion velocity. A and B are constant. (auth)

51551 MEASUREMENT OF THE TOTAL CROSS SECTIONS OF POSITRONS ON HELIUM ATOMS IN THE ENERGY RANGE 15 TO 23 eV. Jaduszliwer, B.; Keever, Wm. C.; Paul, D. A. L. (Univ. of Toronto). Can. J. Phys.; 50: No. 12, 1414-8(15 Jun 1972).

Positron cross sections for helium were measured by transmission using a weak beam of energy-analyzed positrons in the range 15 to 23 eV. The positrons are transmitted in a magnetic field parallel to the axis of the scattering chamber. Comparisons with theory are made using several sets of phase shifts, and good agreement is found if the latest p- and d-wave phase shifts of Drachman are used. The experiments fail to show any sharp reduction in the transmission at the positronium threshold; from this an upper limit to the positronium formation cross section of $0.1\ \pi a_0^2$ is deduced. The agreement between these results and those of Costello et al. in the neighborhood of 17 eV is very good. (auth)

Atomic Theory

51552 (LBL-854) CORRELATION OF CORE BINDING ENERGIES BY A POTENTIAL MODEL BASED ON "HALF-IONIZED" CORES AND A NEW METHOD FOR CALCULATING ATOMIC CHARGES. Jolly, William L. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1972. Contract W-7405-eng-48. 21p. (CONF-720909-1). Dep. NTIS.

From General discussion on the photoelectron spectroscopy of molecules; Brighton, England (12 Sep 1972).

The electrostatic potential method of calculating core binding energies (assuming "sudden" ionization) is more appropriate for a hypothetical molecule with its valence electrons polarized as if the core were half-ionized than for a molecule in its initial state. Good correlations of binding energies are achieved by using this concept and a new simple method for estimating atomic charges. (auth)

51553 ENERGY LEVELS OF HYDROGEN-LIKE ATOMS IN A MAGNETIC FIELD. Praddaude, H. C. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., A; 6: No. 4, 1321-4(Oct 1972).

A new expansion of the wave function in Laguerre polynomials for hydrogen-like atoms in a magnetic field has been developed. This expansion reduces the Schrödinger equation to an infinite set of algebraic equations for which a fast, accurate, and unambiguous calculation of the bound states of a hydrogen atom in a magnetic field is possible. Four quantum numbers (K, C, M, N) are used to label the energy levels of the system in cylindrical coordinates. When the magnetic field is zero, the new labeling of the states is equivalent to the standard (n, l, m) quantum numbers obtained for the Coulomb potential in spherical coordinates. Numerical results are presented for the first 14 energy levels with principal quantum number $n = 1, 2, 3$. Several energy-level crossings occur in the region $0 < \gamma < 1$, where $\gamma = \hbar\omega_c/2R$ and R is the effective Rydberg energy. (auth)

51554 SEMI-EMPIRICAL MODEL FOR ELECTRONS IN HEAVY ATOMS AND POSITIVE IONS. Srivastava, Manju; Kothari, L. S. (Univ., Delhi). Phys. Rev., A; 6: No. 4, 1340-8 (Oct 1972).

A semi-empirical model for electrons in atoms, which improves upon the Thomas-Fermi model in two ways, is proposed. It gives the correct wave-mechanical electron density near the nucleus and an exponentially decreasing density (as required by Hartree-Fock calculations) at large distances from the nucleus. The diamagnetic susceptibility, polarizability, and potential at the nucleus for various Z values were calculated and compared with available experimental data. The agreement between the two sets of results is found to be more satisfactory than that obtained by earlier statistical or semi-statistical models. The model is also extended to positive ions. The calculated values of second-ionization energies for atoms with large Z are found to be in very good agreement with experimental data. (auth)

51555 EFFECT OF PRESSURE ON ELECTRONIC STATISTICAL SUMS OF ATOMS AT HIGH TEMPERATURES. Zaitsev, A. A.; Kotomina, R. A. This paper was summarized in At. Energ. (USSR); 30: No. 5, 450(May 1971) as paper No. 493/5948. (In Russian).

Full copy of this paper is held by TIC.

An approximate method is proposed for limiting the electronic energy levels of an atom (or monatomic ion) present in a weakly ionized plasma at high temperatures. The atom is treated as a system consisting of a nucleus and an electron gas surrounding the nucleus. The energy-level cutoff parameter ΔE is the distance from the nucleus at which the pressure exerted by the electron gas becomes equal to the external gas pressure. A formula relating ΔE and the pressure and temperature of the monatomic gas is obtained. The example of the Pb atom is used over a broad range of temperatures and pressures in calculating ΔE and comparing this method to other methods. The procedure is used to calculate ΔE for the uranium atom for temperatures up to 10,000°K and pressures from 0.01 to 100 atm. For these data, values of the natural logarithm of the electronic statistical sum and the reduced thermodynamic potential of U in the ideal gas state are obtained. (A.G.W.)

51556 DEPENDENCE OF THE ELECTRONIC STATISTICAL SUM OF ATOMS ON THE CUTOFF PARAMETER OF ENERGY LEVELS. Zaitsev, A. A.; Kotomina, R. A. This paper was summarized in At. Energ. (USSR); 30: No. 5, 449-50(May 1971) as paper No. 492/5949. (In Russian).

Full copy of this paper is held by TIC.

The dependence of the electronic statistical sum of the atom (or monatomic ion) on the cutoff parameter of the energy levels ΔE was studied. A formula is proposed for computing the electronic statistical sum for any ΔE however small, provided the lowermost levels and the ionization potential of the atom are known. The problem of approximate treatment of the contribution made by the highest energy levels to the electronic portion of the statistical sum is also discussed. Results of computations for indium and lead atoms for temperatures up to 14,000°K are included. (A.G.W.)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

51557 (AD–737289) INVESTIGATIONS ON THE DYNAMICS OF MHD FLOWS. Annual Technical Report No. 3, January 1–December 31, 1971. Wilhelm, Horst E. (Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering). 15 Jan 1972. Contract N00014-67-A-0299-0008. 102p. NTIS.

Theoretical investigations on plasmas in MHD flows and energy conversion systems are reported. The spatial development of the boundary layer and the onset of separations in magnetohydrodynamic flows between diverging duct walls is investigated by similarity methods and within the frame of the boundary-layer approximation. An analytical solution is presented for the nonlinear initial-boundary-value problem describing the diffusion and convection of plasmas in presence of ionization and recombination reactions. A plasma turbulence theory is formulated that is based exclusively on the first principles of classical statistical mechanics. (auth) (NTIS)

51558 (AD–737727) ANALYSIS OF MHD FLOW AND HEAT TRANSFER IN LAMINAR PIPE FLOW IN A RADIAL MAGNETIC FIELD. Fuller, F. L. (Grumman Aerospace Corp., Bethpage, N. Y. Research Dept.). Feb 1972. 39p. (RE–420). NTIS.

A solution is obtained for the fully-developed pipe flow problem for a conducting liquid in a radial magnetic field. The resulting velocity profiles and friction factors are valid over a large range of Hartmann numbers. Based on the new solutions for velocity, the energy equation, including the viscous and ohmic dissipation terms, is solved. Nusselt number is obtained as a function of Hartmann number and dimensionless temperature profiles are presented as a function of Hartmann number and a parameter dependent upon the ratio of ohmic heating to wall heat transfer. Large magnetic influence on the temperature profiles is shown to be possible. (auth) (NTIS)

51559 (CONF-710964) PROCEEDINGS OF THE THIRD RENO CONFERENCE ON MAGNETIC FIELDS AT THE UNIVERSITY OF NEVADA, RENO, NEVADA, SEPTEMBER 2 AND 3, 1971. (Nevada Univ., Reno (USA). Dept. of Electrical Engineering). 1971. 292p.

Separate abstracts were prepared for 5 of the included papers. The remaining papers were not in the scope of NSA and hence omitted. (M.O.W.)

For abstracts of individual papers see: 51201, 51241, and 51560–51562.

51560 (CONF-710964–, pp 8-26) COMPUTERIZED SOLUTIONS OF THE INDUCED MAGNETIC FIELD IN MHD CHANNEL. Denno, K. (Newark Coll. of Engineering, N. J.). 1971.

From third Reno conference on magnetic fields; Reno, NV. (2 Sep 1971).

Calculations are presented for the induced magnetic field in a magnetohydrodynamic channel of two infinite parallel plates. The exciting source is due to an infinite conductor carrying dc current, and the fluid is inviscid, incompressible, and thermally nonconducting. The calculations showed the dominant effect of the axial transverse component; the magnetic pressure is of the same order as the magnetic Reynolds number and that the channel height has a significant influence on the induced field and the magnetic pressure. Computerized solutions supplemented the analytical work in multi-layers above the channel wall adjacent to the magnetic field source. Their peak values and magnetic pressure were obtained with respect to channel length, height, and fluid properties. (M.O.W.)

51561 (CONF-710964–, pp 27-46) MAXWELL'S STRESS FORCE ALONG A CURVED CONDUCTOR IN A MAGNETIC FIELD. Schrade, H. O. (Aerospace Research Labs., Wright Patterson AFB, Ohio). 1971.

From third Reno conference on magnetic fields; Reno, NV (2 Sep 1971).

In order to determine static and dynamic effects on gaseous conductors, it is pertinent to know the resultant electromagnetic force caused by the Maxwell stress around the surface of an arbitrarily curved conductor channel. For a quasi-neutral plasma, as can be assumed valid for most gaseous conductors, the Maxwell stress is a function of the magnetic field only. The magnetic field now results as a sum of the externally applied and the self-induced field. It is shown that the latter can be expressed as the field of two independent current circuits, one of which accounts for the near-range, the other for the far-range contributions of the current elements of the gaseous conductor. Since for many practical conditions, the far field of the conductor is negligible compared to the externally applied magnetic field, this approach allows one to calculate in a consistent way the electromagnetic stress force per unit conductor length as a function of local conductor properties. It turns out that this Maxwell stress force is in first order for r_0/R (r_0 = radius of the conductor channel, R = radius of curvature of the channel), independent of the current density distribution within the channel, but for curved and/or diverging conductors, it represents a quite complex vector that differs drastically from the overall Lorentz force, $\vec{I} \times \vec{B}$. (auth)

51562 (CONF-710964–, pp 60-76) SOLUTION OF MAGNETIC FIELD PROBLEMS INCLUDING TRAVELING WAVES USING FINITE-DIFFERENCE TECHNIQUES. Carpetis, C. (DFVLR-Inst. of Energy Conversion, Stuttgart). 1971.

From third Reno conference on magnetic fields; Reno, NV. (2 Sep 1971).

Numerical solutions using finite-difference techniques are applied to two problems arising through investigations of inductive magnetofluiddynamic (MFD) energy converters. Both cases include imposed traveling magnetic waves. Problems solved include: (1) flow of a conducting medium through a cylinder of infinite length interacting with a coil system without iron sections, and (2) flow of a conducting medium between two flat winding systems with iron cores of finite length. (auth)

51563 EFFECT OF MAGNETIC FIELD OVER THE STRUCTURE OF TURBULENCE. Khare, H. C.; Srivastava, R. S. L. (Univ. of Allahabad, India). Indian J. Pure Appl. Math.; 3: No. 1, 21-3(Jan 1972).

Theodorson (1961) showed that equation of fluid motion can be written in short and exact form with the vorticity $\bar{\omega}$ as the variable. Later on the structure of turbulence was discussed. In the present paper, the authors discuss the effect of a magnetic field over the structure of turbulence. (auth)

51564 EFFECTS OF EXTERNAL CIRCUIT ON MHD COUETTE FLOW BETWEEN CONDUCTING WALLS WITH HEAT TRANSFER. Soundalgekar, V. M.; Haldavnekar, D. D. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Math.; 3: No. 1, 64-81(Jan 1972).

An analysis of MHD Couette flow is presented under the following conditions: the walls are electrically conducting, fully developed flow, the presence of the magnetic field outside the channel, and the walls are either perfectly or not perfectly thermally conducting. Closed-form solutions are derived for flow and temperature fields. The effects of M (Hartmann number); ϕ_1, ϕ_2 (electrical conductance ratios for upper and lower walls); ψ (the thermal conductance ratio for upper and lower walls); and I_y, S (nondimensional parameters) were discussed. (auth)

51565 THEORIYA I RASCHET MAGNITOGAZODINAMICHESKIKH TECHENII V KANALAKH. (Theory and Calculation of Magnetogasdynamic Flow in Channels). Vulis, L. A.; Genkin, A. L.; Fomenko, B. A. Moscow; Atomizdat (1971). 384p.

The first 60 pages of this monograph on magnetogasdynamics deal with the basic equations relating to gas dynamics, the electromagnetic field, magnetic gasdynamics, and kinetics. The theory of magnetogasdynamic generators, edge effects in ducts, and special problems comprise the bulk of the subject matter. The topics of flow of weakly-ionized plasma in MHD ducts at small Reynolds numbers, and the applied aspects of flow processes and energy conversion in linear ducts in conductive MHD generator of direct current are discussed. 360 references. (K.S.W.)

51566 KINETIC PHENOMENA IN ELECTROLYTES IN POROUS SYSTEMS SUBJECT TO A MAGNETOHYDRODYNAMIC PRESSURE. II. Bondarenko, N. F.; Gak, E. Z.; Komarov, G. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 354-6(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 446-9(Feb 1972).

Phenomena are treated associated with steady-state and transient phenomena in aqueous electrolyte solutions in capillaries with permeable walls subject to magnetohydrodynamic forces in the initial region of the capillary. Expressions are derived for the liquid flow speed through the pores, the electrical and mass transfer through the capillary walls, and most of the basic parameters of the physicochemical and hydrodynamic processes in the capillary. (auth)

51567 KINETIC PHENOMENA IN ELECTROLYTES IN POROUS SYSTEMS SUBJECT TO A MAGNETOHYDRODYNAMIC

PRESSURE. I. Bondarenko, N. F.; Gak, E. Z.; Komarov, G. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 350-3(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 442-6(Feb 1972).

An analysis is made of phenomena associated with steady-state and transient hydrodynamic phenomena in aqueous electrolyte solutions in capillaries with rigid impermeable walls under the action of magnetohydrodynamic forces in the initial region of the capillary. Expressions are derived for the flow velocity in the presence of steady-state and transient magnetohydrodynamic pressure for a capillary segment of infinite length with the rheological properties of the liquid taken into account. (auth)

51568 NONSTEADY-STATE MAGNETOHYDRODYNAMIC COUETTE FLOW WITH ZERO NET FLUID FLOW. Khozhainov, A. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 260-3 (Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 328-32(Feb 1972).

An approximate theoretical analysis is made of the nonsteady-state case of laminar magnetohydrodynamic Couette flow with zero net fluid flow when a boundary is abruptly set into motion at constant velocity. The solution is generalized to the case of an arbitrary time dependence of the boundary velocity. (auth)

51569 LINEAR STABILITY OF FLOW IN A CIRCULAR PIPE IN THE PRESENCE OF A STRONG TRANSVERSE MAGNETIC FIELD. Baldwin, P. (Univ. of Newcastle upon Tyne, Eng.). Quart. J. Mech. Appl. Math.; 25: No. 3, 333-48(Aug 1972).

Electrically conducting fluid with constant fluid properties flows in a circular pipe with an insulating wall under the action of a strong uniform transverse magnetic field. A linear stability analysis of the MHD equations governing the flow, in the small magnetic Reynolds number approximation, shows that instabilities arise in the Hartmann layer on the plane of symmetry parallel to the applied magnetic field, where velocity gradients are greatest. The first two terms in asymptotic expansions for the Reynolds number, and for the wave number and wave speed of the disturbance, are obtained for the onset of marginal stability at large Hartmann number. (auth)

51570 NUMERICAL STUDY OF THE NONLINEAR EXPANSION OF MAGNETOPLASMA SPHERE. Rimer, Norton. New York; City Univ. of New York (1972). 172p. University Microfilms Order No. 72-22,329.

Thesis.

The expansion of a highly heated plasma sphere into an ambient magnetohydrodynamic medium containing a uniform magnetic field is studied. The expanding plasma compresses the medium in front of it, creating a shock wave which is distorted into an elliptic shape by the magnetic field. A two-dimensional MHD computer code is developed to study this problem. It is assumed that the expansion is governed by the non-dissipative MHD equations which are written in Lagrangian coordinates. Since some dissipation is necessary to obtain the correct solution across shock waves, the artificial viscosity method of von Neumann and Richtmeyer, developed for gasdynamics, is extended to the MHD problem. The computer code provides rezoning to restore the Lagrangian mesh, distorted by the plasma motion, to a regular shape. Two mathematical models of the plasma expansion are studied, the spherical piston model; an infinitely conducting, rigid spherical piston expanding at a constant speed, and the blast wave model; a sphere of plasma initially at a uniform pressure and internal energy several orders of magnitude higher than that of the ambient medium. A comparison of the results obtained using the two models is made. These results are also compared with solutions to simplified models in planar geometry. (Diss. Abstr. Int., B)

51571 LINEARIZED ANALYSIS OF MAGNETOHYDRODYNAMIC CHANNEL ENTRANCE FLOW. Hwang, C. C. (Univ. of Pittsburgh). Phys. Fluids; 15: No. 10, 1852-4(Oct 1972).

A linearized analysis is employed for solving the magnetohydrodynamic channel entrance flow with parabolic velocity at the entry. The results are compared with those of the finite-difference method. (auth)

51572 MAGNETOGASDYNAMIC ALIGNED FLOWS WITH FINITE ELECTRIC CONDUCTIVITY. Chandna, O. P.; Holmes, R. W. (Univ. of Windsor, Ont.). Can. J. Phys.; 50: No. 12, 1273-6(15 Jun 1972).

It is established that the steady, axially symmetric flow of a compressible, electrically conducting fluid with finite conductivity has either zero charge density or an irrotational magnetic field. Some properties and solutions of these flows are studied for plane and axially symmetric flows. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 50693, 51207, 51210, 51224, and 51232.

51573 (BNL–16829) NEW PARTICLE SEARCHES AND HIGH TRANSVERSE MOMENTUM EVENTS. Peoples, Charles (Brookhaven National Lab., Upton, N. Y.). 25 Jan 1972. 14p. Dep. NTIS.

It is pointed out that an experiment which is used to study particle production at 90° is useful for a search for quarks if the apparatus can measure momenta of twenty GeV/c. This sets the length of the apparatus at about thirty to forty feet. Quark and hadron production at 90° at high momenta and the experimental apparatus are discussed. (J.F.P.)

51574 CURRENT STATUS OF THE QUEST FOR QUARKS. Kim, Y. S. (Ohio State Univ., Columbus); Kwak, N. Fields Quanta; 3: No. 1, 1-138(Jul 1972).

A review of quark searches in air showers, terrestrial matter and stellar objects is presented. (auth)

51575 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1973. PART 3. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-SECOND CONGRESS, SECOND SESSION, ON PHYSICAL RESEARCH, FEBRUARY 29 AND MARCH 1, 1972. Washington, D. C.; Joint Committee on Atomic Energy (1972). 896p. GPO $3.75.

Witnesses from the AEC presenting testimony include Robert H. Bauer, Commissioner Clarence E. Larson, Dr. Paul W. McDaniel, Dr. John R. Totter, and Dr. William A. Wallenmeyer. Other witnesses include Dr. Allan D. Bromley, Dr. Darrell J. Drickey, Dr. Tsung-Dao Lee, Dr. Edward J. Lofgren, Dr. Homer A. Neal, Dr. Wolfgang Panofsky, Hon. Melvin Price, Dr. Norman F. Ramsey, Dr. Louis Rosen, Dr. Victor F. Weisskopf, Dr. William J. Willis, and Dr. Robert R. Wilson. Also included are selected articles and releases, correspondence, charts and illustrations, and reports relevant to the USAEC high-energy physics program. Pertinent survey articles, panel discussions, fact sheets, and AEC reports are presented which described the status and viability of USAEC high energy physics, medium energy physics, low energy physics, mathematics and computer research, chemistry research, metallurgy and materials research, and controlled thermonuclear research programs. (W.H.K.)

51576 HOLOGRAPHY IN HIGH ENERGY PHYSICS. Soroko, L. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 688-732(1972). (In Russian).

The investigations in holography and processing of optical information related to the techniques of high energy particles experiments are presented. The principles of holography, the backgrounds of the Fourier optics and the computer synthesis of the hologramms and kinoforms are briefly outlined. The holographique track chambers, the simulation experiments with hologramms and the dark field photographic systems with low light background are described. The potentialities of the picture processing of track chamber photographs are illustrated by the examples: the decadique filters and the events recognition by the angle of scattering of the straight tracks. Finally the more distant relations between the holography and nuclear sciences and also the computer-holography interference in the field of processing of the optical information are briefly described. (auth)

Electromagnetic

Refer also to abstract 51245.

51577 (AD–739348) ASYMMETRY MEASUREMENTS FOR NEUTRAL PION AND POSITIVE PION PHOTOPRODUCTION BY LINEARLY POLARIZED GAMMA RAYS IN THE ENERGY RANGE 400 TO 900 MeV. Zdarko, R. W.; Dally, E. B. (Stanford Univ., Calif. High-Energy Physics Lab.). Oct 1971. 18p. (HEPL–661). NTIS.

The asymmetry ratio A = sigma normal − sigma parallel/sigma normal + sigma parallel was measured using linearly polarized gamma-rays for neutral pion photoproduction. For the reaction gamma + p → n + positive pion, measurements were taken for theta$_{\mathrm{cm}}$ = 135 degrees at gamma-ray energies ranging from 390 to 909 MeV. For the reaction gamma + p → p + neutral pion, measurements were taken for theta$_{\mathrm{cm}}$ = 60 degrees and 90 degrees at gamma-ray energies ranging from 426 to 918 MeV. (auth) (NTIS)

51578 (BNL–16815) STUDY OF ELECTROMAGNETIC INTERACTIONS WITH e-P COLLIDING BEAMS. Orear, Jay (Brookhaven National Lab., Upton, N. Y.). 22 Nov 1971. 15p. Dep. NTIS.

Both e-P elastic and inelastic scattering of a 10-GeV electron beam on a moving proton target are discussed. Detection schemes are proposed for a proton energy of 200 GeV and e-P luminosity of 10^{33} cm^{-2} sec^{-1}, and the experimental limits in Q^2 and ν are estimated. (auth)

51579 (BNL–16837) TEST OF CPT AT VERY SMALL DISTANCES. Marx, Jay (Brookhaven National Lab., Upton, N. Y.). Jan 1972. 9p. Dep. NTIS.

An experiment is proposed which can be done at Isabelle to test the CPT theorem at distances less than $7(10)^{-16}$ cm. This experiment consists of determining the difference in cross sections for $e^+\bar{p}$ and e^-p interactions as a direct measure of CPT invariance. The elastic and inelastic cross sections are plotted, and the luminosity is determined. (J.F.P.)

51580 (BNL–17094) ELECTRON–PROTON ELASTIC AND INELASTIC SCATTERING AT ISABELLE. Orear, Jay (Cornell Univ., Ithaca, N. Y.). 26 Jul 1972. 12p. Dep. NTIS.

Both e-p elastic and inelastic scattering of a 10-GeV electron beam on a moving proton target of 200 GeV (equivalent to 4260 GeV electrons against a stationary target) are discussed. With a luminosity of 10^{32} cm^{-2} sec^{-1} it is estimated that e-P elastic scattering can reach $Q^2 \approx 10$ GeV^2 and e-P inelastic can reach $Q^2 > 3000$ GeV^2 with rates of several events per day. (auth)

51581 (LNF–72/32) GAMMA–GAMMA INTERACTION PROCESSES AT ADONE e^+e^- STORAGE RING. MEASUREMENT OF THE REACTION $e^+ + e^- \rightarrow e^+ + e^- + e^-$. Bacci, C.; Baldini-Celio, R.; Capon, G.; Mencuccini, C.; Murtas, G. P.; Penso, G.; Reale, A.; Salvini, G.; Spinetti, M.; Stella, B. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 17 Apr 1972. 8p. Dep. NTIS (U. S. Sales Only).

The interaction $e^+ + e^- \rightarrow 2e^+ {}_+ 2e^-$ at 2 GeV was studied. The cross sections were evaluated, and the distribution of velocity of the center of mass of two electrons emitted at wide angles is given. (J.F.P.)

51582 (LNF–72/42) EVALUATION OF PHOTON–PHOTON ANNIHILATION CONTRIBUTIONS IN A WIDE ANGLE EXPERIMENT AT ADONE. Barbarino, G.; Ceradini, F.; Grilli, M.; (and others) (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 18 May 1972. 12p. Dep. NTIS (U. S. Sales Only).

The reactions $e^+ + e^-$ observed at Adone are analyzed in a search for those that could come from $\gamma\gamma$ processes, mainly in order to evaluate possible contaminations due to this mechanism to the one-photon processes. The reliability of this evaluation is tested by comparing at a given total energy the expected and measured number of events due to the $\gamma\gamma$ process. (J.F.P.)

51583 (SLAC-PUB–982) SEARCH FOR MUON-ELECTRON DIFFERENCES. Perl, Martin L. (Stanford Linear Accelerator Center, Calif.). Nov 1971. 52p. (CONF-710933–7). Dep. NTIS.

From Muon physics conference; Fort Collins, Colo. (6 Sep 1971).

A review is given of some recent experimental results on the fundamental nature of the muon and electron and the relation between them. A summary of present knowledge of the existence of other charged leptons, the static and atomic properties of the muon and electron, and the high energy behavior of the charged leptons in electromagnetic and strong interaction processes are covered. Heavier charged leptons, mu-mesic atoms and muonium, charged lepton form factors in high energy interactions, muon–proton elastic and inelastic scattering, speculations on muon form factors and special muon–hadron interactions are discussed. (J.F.P.)

51584 TOTAL PAIR PRODUCTION CROSS SECTION OF γ-RAYS IN HYDROGEN AND DEUTERIUM. Rawlinson, W. R. (Daresbury Nuclear Physics Lab., Warrington, Eng.); Tait, N. R. S.; Thompson, J. C.; (and others). Nucl. Phys.; B45: No. 1, 41-6(1972).

The total electromagnetic cross sections of γ-rays in hydrogen and deuterium were measured over the energy range 265 to 4215 MeV using a photon tagging system. From these measurements, the total pair production cross sections are obtained, and the results are found to be in good agreement with the predictions of Jost, Luttinger and Slotnick. (auth)

51585 Q^0 AND $\overline{Q}^0$ PRODUCTION IN K_L^0p INTERACTIONS FROM 4 TO 12 GeV/c. Brandenburg, G. W.; Brody, A. D.; Johnson, W. B.; (and others) (Stanford Univ., Calif.). Nucl. Phys.; B45: No. 2, 397-427(1972).

Experimental results are presented on the reactions $K^0p \rightarrow Q^0p$ and $\overline{K}^0p \rightarrow \overline{Q}^0p$ observed in the final state $K_S^0\pi^+\pi^-p$ in the momentum range 4 to 12 GeV/c. The data were acquired by exposing the SLAC 1m hydrogen bubble chamber to a neutral beam. Special emphasis is placed on a detailed comparison of the production characteristics of the two strangeness states. Cross sections, differential cross sections, density matrix elements, $K^*\pi$ mass spectra and exponential slopes of the momentum transfer distributions are presented for Q^0p and $\overline{Q}^0p$. An important result of this study is the observation of a crossover at $-t' = 0.13 \pm 0.03$ GeV^2 in the differential cross sections. It is found that this effect is explained in analogy to elastic scattering by assuming that Regge, as well as pomeron, exchange contributes to Q-production. Calculations with a Reggeized Deck model are also made and it is found that such models, as presently formulated, cannot explain the observed behavior of the differential cross sections or the energy dependence of the Q cross section. (auth)

51586 PSEUDO-MAGNETIC NUCLEAR RESONANCE OF THE NEUTRON INDUCED BY A RADIOFREQUENCY NUCLEAR FIELD. Bacchella, G. L.; Glattli, Hans; Meriel, Pierre; (and others) (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 274: No. 6, 423-6(7 Feb 1972). (In French).

The phenomenon observed is explained by a series of analogies with well established phenomena concerning resonance and magnetic diffusion of the neutron. (France)

51587 π^-/π^+ RATIO OF PHOTOPRODUCTION ON DEUTERIUM FOR ENERGIES BETWEEN 240 AND 400 MeV. Von Holtey, G.; Knop, G.; Stein, H.; Stuempfig, J.; Wahlen, H. (Univ., Bonn). Phys. Lett.; 40B: No. 5, 589-92(7 Aug 1972).

The π^-/π^+ ratio for photoproduction on deuterons was measured for photon energies between 240 and 400 MeV at CM-angles from 15 to 180°. Using the π^+-photoproduction on protons, measured with the same apparatus, the π^--production on neutrons is calculated. Comparison with π^+ shows no isotensor contribution, whereas the inverse reaction deviates considerably in the resonance region. (auth)

51588 MEASUREMENT OF THE INCLUSIVE ELECTROPRODUCTION OF HADRONS. Dakin, J. T.; Feldman, G. J.; Lakin, W. L.; (and others) (Stanford Univ., Calif.). Phys. Rev. Lett.; 29: No. 11, 746-9(11 Sep 1972).

The electroproduction of hadrons was studied with a wide-aperture spectrometer. Inclusive data are presented for the electron-scattering region $-0.5 > q^2 > -2.5$ (GeV/c)^2, $4 < \nu <$ 14 GeV. Distributions of the electroproduced hadrons in the three inclusive variables φ, $p_\perp^2$, and x are studied in the region $x > 0$. A striking difference from photoproduction is observed in the excess of positive over negative hadrons at high x and high q^2. (auth)

51589 NEW MEASUREMENT OF μ_p/μ_N AND THE MASS DOUBLET $H_2^+-D^+$. Luxon, James L.; Rich, Arthur (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett.; 29: No. 10, 665-8 (4 Sep 1972).

A new technique for measuring ion cyclotron frequencies was developed. The results $\mu_p'/\mu_N = 2.792\ 786 \pm 0.000\ 017$ (6.0 ppM) and the mass difference $H_2^+-D^+ = 1548.22 \pm 0.20$ μu are reported. These are in agreement with previous measurements. (auth)

51590 INCLUSIVE PION DISTRIBUTIONS IN ELECTROPRODUCTION. Lazarus, E. (Cornell Univ., Ithaca, N. Y.); Andrews, D.; Berkelman, K.; (and others). Phys. Rev. Lett.; 29: No. 11, 743-6(11 Sep 1972).

Measurements are reported for the process $e + p \rightarrow e + \pi^+ +$ anything. Partial multiplicities and average transverse momenta show no significant dependence on Q^2. (auth)

51591 HADRONIC PRODUCTION BY e^+e^- COLLISIONS AT THE ENERGY 990 MeV WITH THE ORSAY STORAGE RING. Cosme, G.; Jean-Marie, B.; Jullian, S.; (and others) (Universite Paris Sud, Orsay, France). Phys. Lett.; 40B: No. 6, 685-8(21 Aug 1972).

Data were taken at the energy 2E = 990 MeV to search for multibody events, with the same large-solid-angle detector which has been used for the measurement of the ρ,ω, and ϕ production by e^+e^- annihilations. If $\pi^+\pi^-\pi^0\pi^0$ production occurs by the quasi-two-body process $e^+e^- \rightarrow \rho \rightarrow \omega\pi^0$, the corresponding cross section is $\sigma(e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0) = (1.1 \pm 0.5)\ 10^{-32}$ cm^2. Since no events with 3 and 4 charged pions were observed, $\sigma(e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-) \leq 1.5 \times 10^{-33}$ cm^2. (auth)

51592 $X^0 \rightarrow 2\gamma$ FROM $\pi^-p \rightarrow$ NEUTRAL MESON + NEUTRON AT 3.8 GeV/c. Apel, W. D. (Univ. Karlsruhe, Ger.); Auslaender, J.; Mueller, H.; (and others). Phys. Lett.; 40B: No. 6, 680-4 (21 Aug 1972).

The branching ratio $X^0 \rightarrow 2\gamma/X^0 \rightarrow$ all was found to be (2.9 ± 0.9)%. (auth)

51593 ASYMMETRY IN THE COHERENT PHOTOPRODUCTION OF π^0 ON DEUTERONS BY POLARIZED GAMMA-RAYS. Bologna, G. (CNEN, Frascati, Italy); Peruzzi, I.; Piccolo, M.; Troise, G. Nuovo Cim., A; 10: No. 4, 703-12(21 Aug 1972).

The asymmetry ratio in the coherent photoproduction of π^0-mesons on deuterons was measured in the region of the first resonance, by using the Frascati linearly polarized γ-ray beam. The mean value obtained, $\Sigma = 0.63 \pm 0.03$, is of the same order and sign as the asymmetry in the photoproduction on protons. The dependence of the asymmetry on energy and angle is also given within the limits of the acceptance of the experimental apparatus. (auth)

51594 PHOTOPRODUCTION OF π^0-MESONS BY HELIUM WITH 160 TO 240 MeV PHOTONS. Belousov, A. S.; Rusakov, S. V.; Tamm, E. I.; (and others). Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 78-129(1971). (In Russian).

Values for the differential and total transverse cross sections of elastic photoproduction of π^0-mesons by helium with 160- to 240-MeV photons were obtained. The measured values of the differential cross sections agreed with those calculated, the latter computations being based on the theory of a relativistic momentum approximation in the bremsstrahlung region of energy $E_\gamma \leq 200$ MeV. An experimental value was found for the amplitude of π-meson photoproduction by a nucleon for $\langle r \rangle_{He} = 1.4$ f. (tr-auth)

Weak

51595 (BNL-16808) ISABELLE PROJECT NON-HADRONIC INTERACTIONS STUDY GROUP. Interim Report. Willis, W. J. (Brookhaven National Lab., Upton, N. Y.). 14 Sep 1971. 6p. Dep. NTIS.

Experiments that might be done at the ISABELLE facility on nonhadronic interactions are discussed. At least initially the experimental possibilities will probably be limited to p–p storage rings. It is felt that experiments on nonhadronic interactions will be interesting, but the answers will probably be different from predictions. (R.W.R.)

51596 (COO-3071-8) SEARCH FOR DOUBLY-CHARGED WEAK CURRENTS THROUGH $K^+ \rightarrow \pi^-e^+\mu^+$. Beier, E. W.; Buchholz, D. A.; Mann, A. K.; Parker, S. H. (Pennsylvania Univ., Philadelphia. Dept. of Physics). 28 Jun 1972. 13p. Dep. NTIS.

Results are presented of a search for the decay mode $K^+ \rightarrow \pi^-e^+\mu^+$ which requires doubly-charged weak currents for its existence. Limits are also obtained on the branching ratios for the decay modes $K^+ \rightarrow \pi^+e^+\mu^-$ and $K^+ \rightarrow \pi^+e^+e^-$. A comparison of some present experimental limits on neutral and doubly-charged weak currents is given. (auth)

51597 (JINR-P2-6447) EXISTENCE OF THE GEIGER–NUTTAL LAW FOR HYPERON DECAY. Isaev, P. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental data on the hyperon decay include some indications for the existence of the hyperon decay law analogous to the Geiger–Nuttal law for the decay of radioactive families. (auth)

51598 SEARCH FOR DOUBLY CHARGED WEAK CURRENTS THROUGH $K^+ \rightarrow \pi^-e^+\mu^+$. Beier, E. W.; Buchholz, D. A.; Mann, A. K.; Parker, S. H. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 29: No. 10, 678-82(4 Sep 1972).

Results of a search for the decay mode $K^+ \rightarrow \pi^-e^+\mu^+$ which requires doubly charged weak currents for its existence are presented. Limits are also obtained on the branching ratios for the decay modes $K^+ \rightarrow \pi^+e^+\mu^-$ and $K^+ \rightarrow \pi^+e^+e^-$. A comparison of some present experimental limits on neutral and doubly charged weak currents is given. (auth)

51599 OBSERVATION OF ELASTIC HYPERON PRODUCTION BY ANTINEUTRINOS. Eichten, T. (Technische Hochschule, Aachen); Faissner, H.; Kabe, S. Phys. Lett.; 40B: No. 5, 593-6(7 Aug 1972).

The production of Λ and Σ^0 hyperons by antineutrinos was observed. These events were used to estimate the production cross section on protons. The result is compared with the predictions of the Cabibbo theory for the process $\bar{\nu}p \rightarrow \mu^+\Lambda$. (auth)

51600 EXPERIMENTAL STUDY OF THE TIME-DEPENDENT RATE OF $K^0 \rightarrow \pi^+\pi^-\pi^0$. Metcalf, M. (CERN, Geneva); Neuhofer, G.; Niebergall, F.; (and others). Phys. Lett.; 40B: No. 6, 703-7 (21 Aug 1972).

The time-dependence of the decay rate of initially pure K^0 into the final state ($\pi^+\pi^-\pi^0$) was studied in search for the decay $K^0_S \rightarrow \pi^+\pi^-\pi^0$. No evidence was found in a sample of 384 observed events. The ratio of the CP-violating K^0_S amplitude and the K^0_L amplitude is $\eta_{\pm 0} = (0.13^{+0.17}_{-0.20}) + i(0.17^{+0.27}_{-0.26})$; the ratio of the CP-conserving K^0_S amplitude and the K^0_L amplitude is $|\rho| < 0.4$. The energy dependence of the $K^0 \rightarrow \pi^+\pi^-\pi^0$ matrix element is found to be $a_{\pm 0} = -0.31 \pm 0.03$. (auth)

51601 SEARCH FOR THE PROCESS $K^+ \rightarrow \mu^+ + \nu + \bar{\nu} + \nu$. Cable, G. D. (Univ. of Chicago); Hildebrand, R. H.; Pang, C. Y.; Stiening, R. Phys. Lett.; 40B: No. 6, 699-702(21 Aug 1972).

A search for the process $K^+ \rightarrow \mu^+ + \nu + \bar{\nu} + \nu$ was made in a counter experiment at the Bevatron. No evidence which implies the existence of this decay mode was found. An upper limit on the branching ratio of 7×10^{-6} (90% confidence) was obtained. (auth)

Strong (Baryon-induced)

Refer also to abstracts 51217 and 51975.

51602 (BNL-16827) MEASUREMENT OF NUCLEON-NUCLEON TOTAL CROSS SECTION RATIOS AT ISABELLE. Goulianos, K. (Brookhaven National Lab., Upton, N. Y.). 10 Dec 1971. 3p. Dep. NTIS.

A proposal is described for the measurement of total pp/nn/pn cross section ratios at cm energies up to 100 GeV per nucleon using intersecting deuteron beams at Isabelle and observing spectator nucleon coincidences with scintillation counters. (J.F.P.)

51603 (JINR-P1-6616) DETERMINATION OF THE FORM-FACTOR OF A DEUTERON FROM EXPERIMENTAL DATA ON ELASTIC (p,d), (p,p), AND (n,p) SCATTERING AT SMALL ANGLES IN THE ENERGY REGION 10 TO 26 GeV. Zolin, L. S.; Nikitin, V. A.; Chyong B'en; Shafranova, M. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The sum of the squares of the form factors in S- and D-states of a deuteron was calculated for values of the square of the transmitted momentum $|t| \leq 0.2$ $(GeV/c)^2$. The calculation was conducted on the basis of Glauber's theory and from experimental data on the differential cross sections of elastic scattering of protons by deuterons, protons by protons, and neutrons by protons in the energy range 10 to 26 GeV. The wave function of Bressel and Kerman yielded excellent agreement with the experimental data from a number of wave functions examined. (tr-auth)

51604 BOSON PRODUCTION WITH MASS ABOVE 1.5 GeV IN $\bar{p}p$ MULTIPION ANNIHILATION AT 6.94 GeV/c. Alexander, G.; Bar-Nir, I.; Benary, O.; (and others). (Tel-Aviv Univ., Israel). Nucl. Phys.; B45: No. 1, 29-40(1972).

Boson resonance production was studied in quasi-two and three-body final states of $\bar{p}p$ annihilations at 6.94 GeV/c leading to six and more pions. Evidence is presented for the existence of heavy bosons $X^0(3.1)$, $X^0(3.4)$ and $X^0(3.6)$ seen in the reaction $\bar{p}p \rightarrow X^0\pi^0$. The $3\pi^+3\pi^-$ decay mode is observed for the $X^0(3.1)$ and $X^0(3.4)$ bosons and decay mode $4\pi^+4\pi^-$ is seen for the $X^0(3.4)$ and $X^0(3.6)$ bosons. The A_3 and a $G = -1$ resonance in the T region are seen to be produced in association with a pion and a vector meson. (auth)

51605 DECAY ANGULAR DISTRIBUTIONS OF $p\pi^-$ STATES FORMED IN DIFFRACTION DISSOCIATION OF NEUTRONS ON CARBON. Vander Velde, J. C. (Univ. of Michigan, Ann Arbor); Jones, L. W.; Longo, M. J.; (and others). Nucl. Phys.; B45: No. 1, 1-11(1972).

Decay angular distributions of the $p\pi^-$ system formed from the interactions of 25 to 30 GeV/c neutrons on a carbon target are presented. The data are studied as a function of t', which allows a partial separation of coherent and incoherent events. It is found that the coherent production goes substantially into $p\pi^-$ states with $J \geq 3/2$ and is consistent with pure $J = 3/2$. No firm conclusion could be drawn about the question of helicity conservation from the data. There is no evidence for coherent production of the known $I = 1/2$ resonances. Comparison is made of the data with predictions of the Drell-Hiida-Deck and double Regge models. In their present form these models do not appear to give satisfactory descriptions of the data. (auth)

51606 TWO-PARTICLE CORRELATIONS IN INCLUSIVE pp INTERACTIONS BETWEEN 13 AND 28 GeV/c. Berger, Edmond L. (Argonne National Lab., Ill.); Oh, B. Y.; Smith, G. A. Phys. Rev. Lett.; 29: No. 10, 675-8(4 Sep 1972).

New data are presented on π^- production in inclusive pp interactions at 13, 18, 21, 24, and 28.5 GeV/c. Mean values $\langle n \rangle$, $\langle n(n-1) \rangle$, and the associated multiplicity $\langle n(y) - 1 \rangle$ are given as functions of s. Single- and two-particle spectra are presented. The nova model reproduces the two-pion inclusive distributions very well and thus explains strong correlations found between π's as a simple manifestation of small inelasticity, observed previously in single-particle spectra. (auth)

51607 DIRECT s-CHANNEL EFFECTS IN THE FINAL STATE $K^0_1K^0_1\omega^0$ IN THE REGION OF THE T-MESON. Donald, R. A. (Univ. of Liverpool); Galletly, J.; Edwards, D. N.; De Billy, L.; Baubillier, M. Phys. Lett.; 40B: No. 5, 586-8(7 Aug 1972).

This collaboration presented to the Lund conference a preliminary report which gave evidence in favor of the existence of a direct channel effect in the reaction $\bar{p} + p \rightarrow K^0_1 + K^0_1 + \omega^0$ at center of mass energies spanning the T meson. That work was based on half the statistics of the experiment, and on a preliminary method of background subtraction. A report based on full statistics is given. (auth)

51608 SEARCH FOR QUARKS AT THE CERN INTERSECTING STORAGE RINGS. Bott-Bodenhausen, M.; Caldwell, D. O.; Fabjan, C. W.; (and others) (CERN, Geneva). Phys. Lett.; 40B: No. 6, 693-8(21 Aug 1972).

No quark candidates were seen among 0.6×10^9 charged particles at the ISR. The corresponding cross-section limit for charge $1/2$ $(2/3)$ is $\lesssim 3(6) \times 10^{-34}$ cm^2 for quark masses up to 22(13) GeV, if $\langle P_T \rangle = 0.4$ GeV/c. (auth)

51609 REACTION $pn \rightarrow pp\pi^-$ AND N* (1450) PRODUCTION AT 5.9 GeV/c. Gage, W.; Colton, E.; Chinowsky, W. (Univ. of California, Berkeley). Nucl. Phys.; B46: No. 1, 21-8(1972).

A search for N* (1450) production was made among the 904 selected examples of the reaction $pd \rightarrow pp\pi^-(p_{sp})$ obtained in a bubble chamber exposure at 5.9 GeV/c incident momentum. The cross section for the reaction $pn \rightarrow pp\pi^-$ is found to be 1.4 ± 0.1 mb. The peripheral data are in good agreement with the predictions of a single-pion exchange model. Approximately 8% of the events can be attributed to N* (1450) production by some other mechanism. (auth)

Strong (Meson-induced)

Refer also to abstracts 51759 and 51784.

51610 (BNL-16911) PION-PROTON INTERACTIONS AT ISABELLE. Baltay, Charles (Brookhaven National Lab., Upton, N. Y.). 5 Apr 1972. 9p. Dep. NTIS.

The feasibility of studying pion-proton interactions at cms energies up to about 300 GeV using the intersecting storage accelerator ISABELLE is discussed. The method considered is to insert a very thin target into one of the proton beams and then focus the secondary pions into a narrow beam which is allowed to clash with the other proton beam. The geometry, event rate estimation, energy region accessible, and experimental difficulties are considered. The interactions $\pi^+ + p$ and $\pi^- + p$ are discussed. (J.F.P.)

51611 (COO-1195-245) SOME 5.0 GeV/c π^-p CROSS SECTIONS. Schultz, P. F. (Illinois Univ., Urbana. Dept. of Physics). Jul 1972. 22p. Dep. NTIS.

Cross sections were determined for several channels involving four- and six-prong $\pi^- + p$ interactions at 5 GeV/c in a hydrogen bubble chamber. (J.F.P.)

51612 (COO-1545-116) MESON-BARYON ELASTIC POLARIZATION AND THE REAL PART OF THE NONFLIP AMPLITUDE. Chiu, C. B. (Texas Univ., Austin. Center for Particle Theory); Wada, W. W. (European Organization for Nuclear Research, Geneva (Switzerland). Ohio State Univ., Columbus. Dept. of Physics). 20 Jun 1972. Contract AT(11-1)-1545. 20p. Dep. NTIS.

The strong central absorption prescription for the nondiffractive helicity-nonflip elastic two-body scattering amplitude that has recently been proposed is briefly discussed, and the experimental indications are presented for this in the crossing even πp and K^-p scattering amplitudes. The strong and weak versions of the prescription are also presented. (auth)

51613 (INR-P–1411) CHARGED AND NEUTRAL PARTICLE MULTIPLICITY IN π^-p AND π^-n INTERACTIONS AT 40 GeV/c. Bucharest-Budapest-Krakow-Dubna-Hanoi-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan Bator-Warsaw Collaboration. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 19p. Dep. NTIS (U. S. Sales Only).

Data on multiplicity of charged particles and π^0 mesons in π^-p and π^-n interactions at 40 GeV/c are presented. Charged particle multiplicity distributions are well described by the Wang model I and the empirical formulas of Czyzewski and Rybicki and of Bozoki et al. The average number of π^0's is 2.51 ± 0.06 per inelastic π^-p event and 2.39 ± 0.09 per inelastic π^-n event. The average π^0 multiplicity tends to increase with increasing number of charged particles. The results agree with a model which assumes the Czyzewski–Rybicki formula for the distribution of the total particle multiplicity and the isospin independence hypothesis. (auth)

51614 (RPP/H–96) FOUR- AND FIVE-BODY K^+p INTERACTIONS AT 2.11, 2.31, 2.53, AND 2.72 GeV/c. Lewis, P. H.; Allen, J. E.; Jacobs, N. J. D.; (and others) (Rutherford High Energy Lab., Chilton (England)). 1971. 58p. Dep. NTIS (U. S. Sales Only).

The K^+p interactions with production of 2 or 3 pions are studied at 2.11, 2.31, 2.53 and 2.72 GeV/c incident K^+ momenta. The cross sections are given for different reaction channels and for the production of resonances: $K^*(892)$, $\Delta(1231)$, η^0, ω^0 and ρ. An analysis of the enhancement in the $K\pi\pi$ mass distributions around 1.26 GeV shows that at least a part of this enhancement is due to nondiffractive production of a resonance Q with mass M = 1.260 GeV and width Γ = 0.047 GeV. A study of the production and decay angular distributions of Δ^{++} and $K^{*0} \to K^+\pi^-$ indicates that the reaction $K^+p \to K^*\Delta$ is dominated by pion exchange but this mechanism is not sufficient to obtain a good description of the data. A dependence of the shape of Δ^{++} on the momentum transfer is observed. (auth)

51615 (RPP/H–100) EXPERIMENTAL DEMONSTRATION OF DUALITY IN $K^-p \to \Lambda\pi$, $\Lambda\eta$. Litchfield, P. J. (Rutherford High Energy Lab., Chilton (England)). 1972. 10p. Dep. NTIS (U. S. Sales Only).

A form of duality is demonstrated in the reactions $K^-p \to \Lambda\pi$ and $K^-p \to \Lambda\eta$ between 1.25 and 1.85 GeV/c. Throughout this region known to be dominated by s channel resonance formation the forward differential cross sections can be well related assuming SU(3) and the exchange of K* and K** trajectories. (auth)

51616 MULTIPLE STRANGE-PARTICLE PRODUCTION BY 10 GeV/c K^+ MESONS IN HYDROGEN. Votruba, M. F. (Univ. of Birmingham, Eng.); Safder, Ali; Ratcliffe, T. M. Nucl. Phys.; B45: No. 1, 77-87(1972).

Production cross sections for channels involving Ξ^+ particles ($20.9^{+6.1}_{-5.4}$) μb, Ξ^- particles (2.3 ± 1.0) μb, $\bar{\Omega}^+$ particles (an upper limit of ≲ 1 μb), and other strange particle channels, are given. An $\bar{\Xi}^+$ production mechanism is suggested, in terms of a double-Regge exchange model, not involving exotic trajectories. The values of the $\bar{\Xi}^+$ mass (1321.6 ± 0.8) Mev/c^2 and lifetime ($1.55 \pm ^{0.35}_{0.20}$) $\times 10^{-10}$ sec are in good agreement with those of the Ξ^-. (auth)

51617 APPROACH TO FACTORIZATION AND SCALING IN INCLUSIVE REACTIONS. Ferbel, T. (Univ. of Rochester, N. Y.). Phys. Rev. Lett.; 29: No. 7, 448-50(14 Aug 1972).

A compilation is presented of existing data on inclusive reactions which provide evidence for the factorization hypothesis in the "central" region of pion production, but only at infinite beam momentum. The approach to limiting behavior in the central region is consistent with that expected on the basis of the Mueller–Regge formalism. (auth)

51618 EVIDENCE FOR A NEUTRAL MESON AT 1150 MeV. Jacobel, R. W. (Purdue Univ., Lafayette, Ind.); Cheshire, D. L.; Lamb, R. C.; (and others). Phys. Rev. Lett.; 29: No. 10, 671-4(4 Sep 1972).

In a scintillation-counter experiment evidence was obtained for a neutral meson denoted $M^0(1150)$ with a mass of 1148.3 ± 3.3 MeV and a width of $15.0^{+9.0}_{-11.7}$ MeV produced in the reaction $\pi^- + p \to M^0 + n$ at 2.4 GeV/c. (auth)

51619 PRODUCTION OF K*(892) AND K*(1420) IN THE REACTION $K^+d \to K\pi N(N_s)$ AT 4.6 GeV/c. Buchner, K. (Max-Planck-Institut fuer Physik and Astrophysik, Munich); Dehm, G.; Geist, W.; (and others). Nucl. Phys.; B45: No. 2, 333-78(1972).

In a bubble-chamber experiment with the CERN 2 m chamber the reactions (i) $K^+d \to K^+\pi^-pp$, (ii) $K^+d \to K^0\pi^0pp$, and (iii) $K^+d \to K^0\pi^+pn$ were studied at a primary K^+ momentum of 4.6 GeV/c. There is abundant production of K* (892) in reactions (i), (ii) and (iii), of $K^{*0}(1420)$ in reactions (i) and (ii) and of Δ^{++} (1236) in reaction (iii). In reaction (i) backward production of K^{*0} (892) is observed. Reaction and resonance-production cross sections are presented and their energy dependence is investigated. Production and decay angular distributions for the resonance bands are analyzed and compared to the results at other energies. In particular the data pertaining to the reaction $K^+n \to K^{*0}$ (892)p are compared in some detail with those for the reaction $K^-p \to \bar{K}^{*0}$ (892)n. Finally, the evidence from reaction (i) for the existence of K_N resonances other than K* (892) and K* (1420) is discussed. (auth)

51620 REACTION $\pi^+n \to p\omega$ AT 13 GeV/c. Paler, K.; Tebes, J.; Badewitz, R. C.; (and others) (Purdue Univ., Lafayette, Ind.). Lett. Nuovo Cim.; 4: No. 15, 745-8(12 Aug 1972).

Experimental results are presented for the reaction $\pi^+ + n \to p + \omega$ at 13 GeV/c in a deuterium bubble chamber. The production and differential cross sections and density matrix elements are found. It is concluded that the differential cross section has the same shape as that at lower energies with a persistent flattening at t = 0, there is a continued decrease with energy of the percentage contribution of unnatural-parity exchange, and the cross section is consistent with the parametrization $\sigma = Ap^n_{lab}$ with n = 2.4. This value of n is incompatible with simple ρ exchange. (J.F.P.)

51621 $K^{*-}(890)p$ AND $K^{*-}(1400)p$ FINAL STATES IN K^-p INTERACTIONS AT 3.95 GeV/c. Rouge, A. (Ecole Polytechnique, Paris); Videau, H.; Volte, A.; (and others). Nucl. Phys.; B46: No. 1, 29-45(1972).

Differential cross sections and density matrix elements are presented for $K^{*-}(890)$ and $K^{*-}(1400)$ produced in the reaction $K^-p \to K^0\pi^-p$ at 3.95 GeV/c. The cross sections are decomposed into contributions due to different exchange mechanisms. (auth)

51622 HOW WELL DOES AN LPS ANALYSIS SEPARATE PRODUCTION MECHANISMS IN π^+p INTERACTIONS AT 8 AND 16 GeV/c? Aachen-Berlin-Bonn-CERN-Heidelberg Collaboration. Nucl. Phys.; B46: No. 1, 1-20(1972).

A longitudinal phase space (LPS) analysis was performed on the reaction $\pi^+p \to \pi^+\pi^+\pi^-p$ at 8 and 16 GeV/c. Special attention was given to the question of the separation of the various reaction mechanisms. The conclusions are: (i) Dissociation of the pion can be clearly isolated, both at 8 and 16 GeV/c. Baryon dissociation is fairly well separated at 16 GeV/c, but at 8 GeV/c it is strongly contaminated by the reactions $\Delta^{++}\rho^0$ and even more by $\Delta^{++}f$; (ii) The cross section for diffraction dissociation dominated regions of LPS is constant or even slightly increasing between 8 and 16 GeV/c. (auth)

51623 STUDY OF THE EXCHANGE MECHANISMS IN THE RHO PRODUCTION REACTIONS $\pi^\pm p \to \rho N$ AT 16 GeV/c. Aachen-Berlin–Bonn–CERN-Cracow-Heidelberg-Warsaw Collaboration. Nucl. Phys.; B46: No. 1, 46-60(1972).

Results are presented of a study of the reactions $\pi^+p \to \rho^+p$, $\pi^-p \to \rho^-p$ and $\pi^-p \to \rho^0n$, all at 16 GeV/c. For ρ^+ and ρ^-, the $d\sigma/dt'$ distributions have a wide forward dip which results from ω exchange. For ρ^0, the $d\sigma/dt'$ distribution is consistent with having a narrower forward dip as expected for π-exchange. The ω-exchange contribution is isolated from a linear combination of the three differential cross sections. It is found that the variation of the ω-exchange contribution with the energy s is consistent with $s^{2\alpha}\omega^{(t)-2}$ where $\alpha_\omega(t) = 0.5 + t$. Using the Harari absorption model, the radius of interactions is found to be independent of energy. Evidence that exchange of both spin-parity series occurs was obtained from the density matrix elements. The values of $(\rho_{11} + \rho_{1-1})$ indicate that natural parity exchanges become more important at t′ increases. The study of $(\rho^{GJ}_{00}\, d\sigma/dt')$ allows us to isolate an exchange having the quantum numbers I = 0, G = −1, $P(-1)^J = -1$ which may represent the contribution of a "cut," as no particle carrying these quantum numbers is known. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 52300.

51624 (AD–739263) FOUNDATIONS OF SCATTERING THEORY, WITH APPLICATIONS TO PHYSICAL PROBLEMS. Final Report. Sucher, Joseph; Dragt, Alex J. (Maryland Univ., College Park. Dept. of Physics and Astronomy). 1 Mar 1972. 25p. (AFOSR-TR–72-607). NTIS.

The work concentrated in three areas is summarized including: foundations of relativistic quantum theory; properties and interactions of hadrons; and electromagnetic interactions of atoms, ions, and charged particles. (auth) (GRA)

51625 (JINR–E2-5813) INTERNATIONAL JINR–CERN SCHOOL ON HIGH ENERGY PHYSICS. Lectures Submitted to ''Black Sea Summer School'', Varna, Bulgaria, 13–27 June 1971. (Joint Inst. for Nuclear Research, Dubna (USSR)). 154p. (CONF-710652–(Vol.1)).

There were three lectures included. Separate abstracts were prepared for all lectures. (J.F.P.)

For abstracts of individual lectures see: 51656, 51730, and 51811.

51626 (JINR–E2-6612) PHENOMENOLOGY OF HIGH ENERGY COLLISIONS AND SCALING LAW AT SMALL DISTANCE. **Efremov, A. V.** (**Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics**). **1972.** **16p.** **Dep. NTIS (U. S. Sales Only).**

It is shown that the assumption of the scaling behavior at small distance in the γ^5-field theory allows one to understand from an unique point of view the phenomenology of different processes (large angle elastic scattering, scattering in the diffraction region, and deep inelastic processes). Some modifications of this phenomenology are suggested. (auth)

51627 (JINR–P2-6637) STRUCTURE OF SOME MATRIX ELEMENTS OF CURRENT COMMUTATORS. **Bogolyubov, P. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).**

The Fourier transforms of current commutators were earlier represented in terms of scalar functions. It was shown that these functions can be chosen such that they should be causal. This result is extended to more general cases. (auth)

51628 (SLAC-PUB–1019) FINAL STATE HADRONS IN DEEP INELASTIC PROCESSES AND COLLIDING BEAMS. Bjorken, J. D. (Stanford Linear Accelerator Center, Calif.). Feb 1972. 49p. (CONF-710816–23). Dep. NTIS.

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

A review is given of colliding beam processes at very high energies, deep inelastic electroproduction inclusive channels, small photons, and diffraction dissociation of virtual photons, and the role of the parton model in deep inelastic processes. An attempt is made to catalog various options on how the data could behave based on considerations which are as model independent as possible. (J.F.P.)

51629 SPIN ROTATION PARAMETERS FOR INCLUSIVE REACTIONS. Doncel, M. G.; Mendez, A. (Univ. Autonoma, Barcelona). Phys. Lett.; 41B: No. 1, 83-6(4 Sep 1972).

For parity conserving, inclusive reactions of type spin $\frac{1}{2}$ + unpolarized → spin $\frac{1}{2}$ + anything, a set of seven spin rotation parameters is defined, as a generalization of the parameters P, R, A of Wolfenstein. They constitute, with the differential cross section, the whole phenomenological information on this type of reactions for each value of total energy, momentum transfer, and missing mass. Their measurement procedure, by correlated asymmetries of initial and final polarizations, and their allowed positivity domain are explicitly discussed. (auth)

51630 PERIODIC TABLE OF ELEMENTARY PARTICLES. Ayub, S. M. J. Natur. Sci. Math.; 11: No. 2, 103-12(Oct 1971).

A previous discussion of the multiplicity of elementary particles is continued covering the mass quantization of elementary particles between the electron and di-proton, the eight-fold way representation of each elementary particle, the quark as the isotopic spin invariant of the electron, and the rest mass space between the proton and di-proton as an exact reflection or duplication of the one between $e^{\pm}$ and $p^{\pm}$, the multiplicity dimension of each eight-set of elementary particles for the entire range remaining the same as between $e^{\pm}$ and $p^{\pm}$ due to the mass-doublet symmetry. (J.F.P.)

51631 CONSTRAINTS ON ENERGY-DENSITY CURRENT-DENSITY COMMUTATORS. Casher, A.; Gomberoff, L. (Tel-Aviv Univ., Israel). Nucl. Phys.; B45: No. 1, 71-6(1972).

Following a recent analysis on correlations between Schwinger terms and the structure of the energy-density operator, it is shown that whenever the local generalization of the Heisenberg equations of motion for the generators of the internal symmetry group holds, then possible q-number Schwinger terms in equal time commutators involving current divergences and current components vanish. This fact, in conjunction with related results, may be an indication that equal-time commutators between spatial current components are even more singular than suspected. (auth)

51632 MULTIPLICITY DISTRIBUTIONS PREDICTED BY THE UNCORRELATED-JET MODEL. Zalewski, K. (Inst. of Nuclear Physics, Krakow). Lett. Nuovo Cim.; 4: No. 16, 881-4(19 Aug 1972).

A more general though less detailed argument for the uncorrelated jet model for multiplicity distributions of particles produced in the reactions a + b → anything is given. It is assumed that only particles of one kind occur. Mueller has generalized a relation for the average multiplicity at high energies in the multiperipheral model. It is found that the Mueller formula holds for any uncorrelated-jet model which satisfied three given conditions. (J.F.P.)

51633 LIGHT-CONE DOMINANCE AND FINITE-ENERGY SUM RULES. Mazzanti, P.; Venturi, G. (Univ., Bologna). Lett. Nuovo Cim.; 4: No. 16, 836-8(19 Aug 1972).

Finite energy sum rules derived from light-cone commutators are explicitly exhibited, and the information which can be obtained from them examined. The absorptive amplitude for forward scattering of a current off a spin-averaged nucleon is considered. These considerations give an indication of a low effective mass of the current constituents or for light-cone dominance in general. (J.F.P.)

51634 LIMITATIONS ON THE BEHAVIOUR OF THE CROSS SECTIONS FOR HIGH ENERGY ELASTIC AND INELASTIC PROCESSES. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 515-54(1972). (In Russian).

In this review the notion of interaction effective radius is widely used. Limitations of the behavior of elastic and inelastic processes were established. Besides problem of equality of the total cross sections for interaction of particles with antiparticles is considered. On the basis of unitary and analyticity conditions very important conclusions on behavior of differential cross section for multiparticle production with the energy increase in the range of large production angles were obtained. (auth)

51635 VERTEX FUNCTIONS IN CONVERGENT RELATIVISTIC MODEL THEORIES. Kita, Hideji (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2140-1(Jun 1972).

It was previously shown that for any system of interacting particles a corresponding set of generators of Poincare group can be constructed by solving Lie's characteristic commutator equations successively with respect to the coupling constant, provided that those vertex functions, which should be introduced into the primary interaction Hamiltonian taken at the start, act as cutoff factors also, and moreover satisfy a certain set of symmetry conditions. It is shown that a more general class of vertex function than those previously found exist, which satisfy all the conditions. (L.B.S.)

51636 HIERARCHY OF EXOTIC CHANNELS AND THE EARLY SCALING IN INCLUSIVE REACTIONS. Gliozzi, F. (Massachusetts Inst. of Tech., Cambridge). Lett. Nuovo Cim.; 4: No. 16, 900-4(19 Aug 1972).

A criterion for early scaling of single-particle inclusive cross sections for exotic channels is discussed which avoids the difficulties connected with the request of factorization of Regge residues. (J.F.P.)

51637 CURRENT ALGEBRA SUM RULE BY THE HARD-MESON TECHNIQUE. Mukherjee, S. (Himachal Pradesh Univ., Simla, India). Lett. Nuovo Cim.; 4: No. 15, 797-801(12 Aug 1972).

The hard-pion technique was previously used to modify the current algebra sum rule of Fubini, Adler, Dashen, and Gell-Mann. This formalism is studied by considering a simple generalization applicable for unequal current masses. It is shown that the formalism can be made fully consistent. The sum rule obtained has some interesting features, and its validity can be decided upon by the storage ring experiments now in progress. (J.F.P.)

51638 PROPERTIES OF DIFFRACTIVE PRODUCTION PROCESSES AND INCLUSIVE REACTIONS. Kuroda, M. (Tokyo Univ.). Lett. Nuovo Cim.; 4: No. 15, 805-8(12 Aug 1972).

The asymptotic properties of the cross sections for diffractive production processes of large-mass resonances in ab → ab* interactions in the small-t region are found through investigation of inclusive reactions. The prediction for the cross sections for pp → pN(2220) interactions are given. (J.F.P.)

51639 INCLUSIVE SUM RULES FOR ISOTOPIC SPIN. Di Giacomo, A. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.; 40B: No. 5, 569-72(7 Aug 1972).

Inclusive sum rules for nonabelian symmetry generators and in particular for isospin are studied. A compact formalism is introduced which allows one to extract in a simple way all the consequences of invariance properties. (auth)

51640 PARTICLES OF ANTIMATTER. Prokoshkin, Yu. D. (Inst. of High Energy Physics, Serpukhov, USSR). Naturwissenschaften; 59: No. 7, 281-4(Jul 1972).

New antimatter particles have been produced. The experimental work is summarized. Future experiments may elucidate the role that antimatter plays in the universe. (auth)

51641 CONSEUQUENCES OF INCLUSIVE CROSS SECTION SUM RULES DERIVED FROM CHARGE AND STRANGENESS CONSERVATION. Gupta, V. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 4: No. 15, 761-4(12 Aug 1972).

Sum rules derived from charge and strangeness conservation are used to show that the width of the multiplicity distribution of all charged particles is expected to be approximately twice that of a Poisson distribution. (J.F.P.)

51642 POMERANCHUK THEOREM FOR ELASTIC DIFFRACTION PEAKS. Cornille, H.; Martin, A. Phys. Lett.; 40B: No. 6, 671-4(21 Aug 1972).

Under weak smoothness assumptions on the modulus of elastic scattering amplitudes in the physical region, positivity properties of the absorptive parts are used to prove that the ratio of the widths of the diffraction peaks for reactions $A + B \to A + B$ and $\bar{A} + B \to \bar{A} + B$ approaches unity at infinite energy. It follows that, if persistent shrinking is observed for one of the two reactions, the same must be true for the other one at sufficiently high energies. (auth)

51643 NEW PROOF OF ASYMPTOTIC EQUALITY OF DIFFERENTIAL CROSS SECTIONS. Medvedev, S. Yu.; Lomsadze, Yu. M. (Inst. for Theoretical Physics, Uzhgorod, USSR). Nucl. Phys.; B46: No. 1, 284-94(1972).

A new proof of the asymptotic equality of the differential cross sections of direct and crossed reactions for $s' \to \infty$ and t' fixed and also for $s' \to \infty$ and $t' = t'(s')$ is given (the prime above s and t indicated their belonging to the physical region). This proof is based on the Meyman theorem 3, which makes it possible to demonstrate it under weaker assumptions than those in the equality proof given by Meyman in 1964. (auth)

51644 UNITARITY BOUND FOR TRIPLE-REGGE COUPLINGS. Rabl, A.; Rabl, V. (Univ., Bonn). Lett. Nuovo Cim.; 4: No. 12, 511-16(22 Jul 1972).

Unitarity bounds for triple-Regge couplings in inclusive interactions are obtained. The total three-particle cross section is written as a particular discontinuity in the amplitude, and bounds are obtained on the trajectories by demanding consistency in asymptotia. (L.B.S.)

51645 IINFINITE-MOMENTUM LIMIT OF FACTORIZABLE CURRENT ALGEBRAS. Divakaran, P. P. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cim., A; 10: No. 4, 613-24 (21 Aug 1972).

A simple method of studying factorizable current algebra at infinite momentum is described, starting from the corresponding finite-momentum representations. It is shown that, for these algebras, the infinite-momentum limit of the current commutator is well defined. Other points discussed include the explicit construction of all operators at infinite momentum as functions of their finite-momentum counterparts, the derivation of the decoupled angular contributions and the mass degeneracy theorem. (auth)

51646 DUAL TOPOLOGY AND INCLUSIVE CROSS-SECTIONS. Brower, R. C.; Waltz, R. E. (CERN, Geneva). Nuovo Cim., A; 10: No. 4, 833-49(21 Aug 1972).

All dual diagrams are classified in terms of self-energy insertions on a finite set of primitive (lowest order) diagrams, and it is conjectured that the important asymptotic effects can be expressed in terms of renormalized primitive diagrams. For total cross sections this is the familiar diffractive plus Regge (resonance) picture, but for inclusive cross sections ($a + b \to c +$ anything) one obtains a more intricate scheme with primitive graphs for diffractive dissociation, and for scaling and nonscaling of the fragmentation and pionization regions. The role of exotic channels in low-energy scaling, and the suppression of the triple pomeron vertex are clarified by this approach. With the assumption of a simple $J = 1$ diffractive pole, the fast-fragmentation graph is calculated (on a computer). Phenomenological features and corrections to pionization and slow fragmentation in the scaling limit are discussed. (auth)

51647 LORENTZ INVARIANCE AND DUALITY. Moen, I. O. (Univ. of Cambridge, Eng.). Nuovo Cim., A; 10: No. 4, 784-98(21 Aug 1972).

The relation between duality and the Lorentz group of space-time transformation is investigated. Although Lorentz invariance does not lead directly to duality, the framework obtained by expressing Lorentz-invariant M-functions in the z-basis provides an interesting framework for studying a possible extension of dual models and suggests a method of incorporating spin for the external particles. It is shown that the n-point Veneziano model and the n-point Virasoro model are special cases of a more general amplitude. (auth)

51648 IMPROVED N/D METHOD FOR INELASTIC PARTIAL-WAVE AMPLITUDES. Wanders, G.; Reuse, F. (Univ., Lausanne, Switzerland). Nuovo Cim., A; 10: No. 4, 759-83(21 Aug 1972).

The problem of constructing the partial-wave amplitudes exhibiting a given left-hand cut and a given inelasticity is reformulated in terms of an improved N/D method. This method presents the following advantages. The form of the basic equations is independent of the asymptotic behavior of the left-hand discontinuity. The effects of inelasticity are evaluated explicitly and disconnected from the effects of the left-hand cut. The inherent ambiguities of an N/D decomposition do not affect the final expression of the scattering amplitude. The CDD pole ambiguity is reduced to the arbitrariness in the choice of a meromorphic function in this final expression. The description of elastic or inelastic resonances serves as illustration of the method. (auth)

51649 CONSTRUCTION OF AVERAGE PHYSICAL AMPLITUDES WITH POSITIVE IMAGINARY PART AND APPLICATION TO THE PROBLEM OF A LOWER BOUND FOR THE ELASTIC CROSS-SECTION. Cornille, H. (CEN de Saclay, Gif-sur-Yvette, France); Martin, A. Nuovo Cim., A; 10: No. 4, 739-46 (21 Aug 1972).

In order to exploit fully the positivity properties it appears often convenient to construct average amplitudes with positive imaginary part for physical transfer values. Such a construction is explicitly given and applied to the problem of lower bounds for the elastic cross section. (auth)

51650 CONSTRUCTION OF PHYSICAL STATES IN THE DUAL-RESONANCE MODEL. Seneor, R.; Soffer, J. (CERN, Geneva). Nuovo Cim., A; 10: No. 4, 641-54(21 Aug 1972).

A method of direct calculation of the states which satisfy the gauge conditions in the case of the intercept $\alpha_0 = 1$ is presented. This is done by applying a nonunitary one-to-one mapping on the space of the states created by the spatial components of the oscillators. The validity of this result is discussed. (auth)

51651 SCATTERING AMPLITUDES OF PARTICLES WITH SPINS OF $h/4\pi$, $h/2\pi$, $3h/4\pi$, AND h/π. Barthelemy, Marie-Claire (Poitiers Univ., France); Jolivet, Andre. Compt. Rend., Ser. A; 274: No. 20, 1469-72(15 May 1972). (In French).

The scattering amplitudes of particles with spins of $h/4\pi$, $h/2\pi$, $3h/4\pi$ and h/π were determined. (France)

51652 INTERPOLATION FORMULA FOR THE SPECTRA OF PARTICLES PRODUCED AT HIGH ENERGY. Kolkunov, V. A.; Ter-Martirosyan, K. A.; Shabel'skii, Yu. M. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 489-92(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 690-4(5 Jun 1972).

An interpolation formula is proposed for the calculation of the spectra of particles produced in inclusive interactions at high energies. (J.F.P.)

51653 PHILOSOPHICAL AND METHODOLOGICAL PROBLEMS IN PHYSICS. Progr. Theor. Phys. (Kyoto), Suppl.; No. 50, 1-248(1971).

Previously published papers of Shoichi Sakata and Mituo Taketani on the philosophy and thought underlying their work, which started with the development of the meson theory of Yukawa, are reprinted in commemoration of the fifteenth year of the Sakata model. The areas covered include a historical introduction to the subject, research contributions of Nobelists, the observation problem in quantum mechanics, developments in the theory of elementary particles, and new concepts of nature in the realms of nuclear physics and astronomy. (R.W.R.)

Electromagnetic

Refer also to abstracts 51517, 51904, 51909, 51973, and 51978.

51654 (BNL–16810) ELECTROMAGNETIC CONTRIBUTIONS TO INELASTIC HADRON PROCESSES. Low, F. E.; Treiman, S. B. (Brookhaven National Lab., Upton, N. Y.). 18 Oct 1971. 20p. Dep. NTIS.

Evidence obtained from inelastic electron scattering experiments supports the possibility that electromagnetic effects may become significant in hadron reactions, for production of particles with sufficiently high transverse momentum. Estimates of the electromagnetic contributions are given, along with much cruder estimates of the crossover transverse momentum where these effects may become competitive with the purely strong interaction contributions. (auth)

51655 (BNL–16828) HIGH ENERGY ELECTROMAGNETIC AND WEAK INTERACTION PROCESSES. Lee, T. D. (Brookhaven National Lab., Upton, N. Y.). 11 Jan 1972. 33p. Dep. NTIS.

A review is given of some known features of the high energy electromagnetic and weak interactions, and speculation is made on some particular aspects of their future possibilities. The scaling hypothesis, applications of the scaling hypothesis, breakdown of the scaling property, limitation of the Fermi theory, divergence difficulties, the indefinite metric, and a new energy scale are treated. (J.F.P)

51656 (JINR–E2-5813, pp 7-35) SCHROEDINGER EQUATION FOR THE RELATIVISTIC TWO-BODY PROBLEM. Todorov, I. T. (Joint Inst. for Nuclear Research, Dubna, USSR. Inst. of Physics, Sofia).

From International school on high energy physics meeting; Varna, Bulgaria (13 Jun 1971).

A relativistic Lippmann–Schwinger equation is derived for the elastic scattering amplitude T from the following general requirements: The equation has to be satisfied identically by the quantum field theoretical perturbative expansion of T. For a hermitian potential it implies the on-shell elastic unitarity condition. For spinless particles and for $m_2 \rightarrow \infty$ it goes into the Klein–Gordon equation for the particle 1 in an external field. The approximate equation obtained by keeping only the lowest order term in the potential is local and yields the relativistic eikonal approximation for small exchange mass and momentum transfer. For the Coulomb potential the corresponding Schrödinger equation is exactly soluble and gives rise to a relativistic Balmer formula including the fine structure splitting as well as recoil effects. (auth)

51657 (JINR–E2-6499) POSITIVITY RESTRICTIONS ON THE IMAGINARY PART OF THE FORWARD PHOTON–PHOTON SCATTERING AMPLITUDES. Kunszt, Z.; Ter-Antonyan, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 6p. Dep. NTIS (U. S. Sales Only).

From the positivity of cross sections exact inequalities are derived for the structure functions of the imaginary part of the forward photon–photon scattering amplitude. (auth)

51658 (JINR–P2-6507) EIKONAL APPROXIMATION FOR DEEP-INELASTIC SCATTERING IN SCALAR ELECTRODYNAMICS. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The deep inelastic scattering is investigated in the model of scalar electrodynamics with massive photons by functional integration method in the eikonal approximation. The structure functions W_i are derived in the Bjorken limit. Scaling is broken by ln ν factors. When $\nu \rightarrow \infty$ νW_2 vanishes as the square of the elastic form factor calculated in the double logarithmic approximation, and W_1 equals zero with the used accuracy. (auth)

51659 (LNF–72/20) RADIATIVE DECAYS OF MESONS AND AN EXTENDED VECTOR MESON DOMINANCE MODEL. Bramon, A.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 19 Mar 1972. 14p. Dep. NTIS (U. S. Sales Only).

A model describing the radiative $P \rightarrow \gamma\gamma$, $V \rightarrow P\gamma$, $P \rightarrow PP\gamma$ and the strong $V \rightarrow PPP$ decays is proposed. The amplitudes for processes with a three-particle final state are approximated by finite dispersion relation and the coupling constants are related by the quark model. Predictions derived from usual VMD are only in qualitative agreement with experiments. Better agreement is achieved by extending VMD with the inclusion of further vector-mesons. (auth)

51660 (LNF–72/30) CONSERVATION CONSTRAINTS FOR e^+e^- ANNIHILATION AND ELECTROPRODUCTION. Etim, E.; Srivastava, Y. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 31 Mar 1972. 6p. Dep. NTIS (U. S. Sales Only).

Some consequences from energy–momentum conservation constraints for e^+e^- annihilation and electroproduction, which show different scaling properties for the distribution function, were obtained. It is shown that for annihilation naive dimensional counting is correct, whereas for electroproduction a different function scales due to the presence of a dimensional parameter in the form of a perpendicular momentum cutoff. Also support is given, though not a proof, for factorization and symmetry properties of the electroproduction distribution functions. (J.F.P.)

51661 (LNF–72/38) CONFORMAL SYMMETRY AT LIGHT-LIKE DISTANCES AND ASYMPTOTIC BEHAVIOUR OF ELECTROMAGNETIC FORM FACTORS. Ferrara, S.; Grillo, A. F.; Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 May 1972. 9p. Dep. NTIS (U. S. Sales Only).

Using conformal symmetry for the operator product of the hadronic electromagnetic current and of the pion interpolating field, at light-like distances, the behavior of the structure function in the scaling limit is connected to the on-mass shell asymptotic behavior of the electromagnetic pion form factor. The results are based on the analysis of the dimension spectrum of local operators appearing in the operator product expansion and on the assumption of precocious scaling. As an application of the results, predictions on the asymptotic behavior of the e.m. pion form factor as well as for the threshold behavior of the structure function for the singly inclusive π-production in e^+e^- annihilation, are given. (auth)

51662 (LNF–72/45) VECTOR MESON DOMINANCE APPROACH TO SCALE INVARIANCE. Bramon, A.; Etim, E.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 22 May 1972. 10p. Dep. NTIS (U. S. Sales Only).

A model of scale invariance for both deep inelastic scattering and e^+e^- annihilation incorporating an infinite number of vector mesons is proposed. Structure functions are calculated explicitly in good agreement with experiments. Precocious scaling arises naturally in the model. (auth)

51663 (LNG–72/50) IMPOSSIBILITY OF ANALYTIC CONTINUATION OF STRUCTURE FUNCTIONS FROM THE DEEP INELASTIC SCATTERING TO THE ANNIHILATION REGION. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Jun 1972. 5p. Dep. NTIS (U. S. Sales Only).

Using a very simple physical argument it is shown that if the interaction is strong enough to form bound states, the structure functions of inclusive e^+e^- annihilation into hadrons, cannot be the analytic continuation of those of deep inelastic scattering. (auth)

51664 (ORO–3992-102) s- AND t-CHANNEL TRANSFORMATION MATRICES FOR HELICITY AND INVARIANT AMPLITUDES FOR $\gamma + N \rightarrow 1^{\pm} + N$. Parsons, Ronald G.; Manny, Ben L.; Clark, Robert Beck (Texas Univ., Austin. Center for Particle Theory). Jun 1972. Contract AT(40-1)-3992. 225p. (CPT–156). Dep. NTIS.

The algebraic transformation matrices, valid for all s and t, connecting the s- and t-channel helicity amplitudes to a corresponding set of gauge invariant covariant amplitudes are presented for the photoproduction processes $\gamma + N \rightarrow 1^+(1^-) + N$. (auth)

51665 (ORO–3992-105). NEUTRINO PRODUCTION BY TWO-PHOTON ANNIHILATION IN A SCALAR-BOSON-EXCHANGE MODEL OF WEAK INTERACTIONS. Biswas, S. N.; Campbell, J. A.; Chaudhuri, R. N.; Taank, J. K. S. (Texas Univ., Austin. Center for Particle Theory). Aug 1972. Contract AT(40-1)-3992. 16p. Dep. NTIS.

The rate of loss of stellar energy through the production of a neutrino-antineutrino pair by the annihilation of two photons is calculated in a renormalizable model of the weak interactions proposed by Kummer and Segrè. The advantage of the calculation is that it is the first for this reaction in astrophysics which is independent of cut-off parameters. The result is identical in its dependence on temperature with a previous expression found by Abak in an intermediate-vector-boson theory, and shows a maximum for a specific ratio of the masses of the two new types of particle needed in the renormalizable model. (auth)

51666 (SLAC-PUB-1039) THEORY OF LEPTON–HADRON INTERACTIONS. Smith, C. H. Llewellyn (Stanford Linear Accelerator Center, Calif.). Apr 1972. 39p. (CONF-720419–2). Dep. NTIS.

From fourth international conference on high energy collisions; Oxford, England (5 Apr 1972).

The discussion covers a relation between the parton model and the formal light cone approach for e + N and ν + N interactions, the quark and multiperpheral models and variable photon radius for exclusive and inclusive electroproduction, and unified renormalizable theories of weak and electromagnetic interactions particularly the reaction $e^+ + e^- \rightarrow W^+ + W^-$. (J.F.P.)

51667 (SLAC-PUB-1054) VECTOR MESON PHOTOPRODUCTION, AMPLITUDE STRUCTURE, AND S-CHANNEL HELICITY CONSERVATION VIOLATION IN POMERON EXCHANGE REACTIONS. Chadwick, G.; Eisenberg, Y.; Kogan, E. (Stanford Linear Accelerator Center, Calif.). Jun 1972. 8p. (CONF-720409-11). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

The experimental data on vector meson photoproduction and Compton scattering are analyzed by utilizing the dual absorptive model. The s-channel helicity conserving (SHC) Pomeron exchange amplitude in ρ^0 and Φ photoproduction is found to shrink with s, in the same way as in π- and K^+-nucleon elastic scattering. The small SHC-violating amplitudes are also studied. The ratio of amplitudes for $|\Delta\lambda| = 1$ to $\Delta\lambda = 0$ at the $\gamma-\rho$ vertex is shown to be similar to the ratio of corresponding πN amplitudes at the proton vertex and both seem to depend only weakly on s. (auth)

51668 (UCRL-74076) ASYMMETRIC NEUTRON–PROTON BREMSSTRAHLUNG AT 130 MeV. Brown, V. R.; Franklin, J. (California Univ., Livermore. Lawrence Livermore Lab.). 11 Aug 1972. 4p. (CONF-720819-3). Dep. NTIS.

From International conference on few particle problems in nuclear interactions; Los Angeles, CA. (28 Aug 1972).

The coplanar asymmetric differential cross sections for neutron–proton bremsstrahlung is calculated at 130 MeV and compared with experiment. (J.F.P.)

51669 REGGE ANALYSIS AND DUAL ABSORPTIVE MODEL FOR $\gamma N \rightarrow \pi^0 N$, $\gamma N \rightarrow \eta N$, AND RELATED PROCESSES. Argyres, E. N. (State University Coll., Plattsburgh, N. Y.); Contogouris, A. P.; Ray, S.; Svec, M. Nucl. Phys.; B45: No. 1, 267-89(1972).

A combined Regge-pole Regge-cut analysis of $\gamma N \rightarrow \pi^0 N$, $\gamma N \rightarrow \eta N$ and of certain processes related by vector dominance is presented. The magnitude of Regge cuts is constrained to satisfy the requirements of the dual absorptive model. Calculations in terms of the weak cut model are also presented and ways to experimentally distinguish between these two models are discussed. The structure of the real and imaginary parts of the amplitudes is also analyzed. (auth)

51670 STATISTICAL CONSTITUENT MODEL FOR THE TIME-LIKE PHOTON IN e^+e^- ANNIHILATION. Griffith, R. W. (Univ., Bonn). Nucl. Phys.; B45: No. 1, 181-204(1972).

Various growths of the meson multiplicity $\bar{n}$ with large, total c.m. energy $\sqrt{q^2}$ in e^+e^- annihilation are related to corresponding behaviors of the single-particle-inclusive, photon-helicity-averaged structure function $\overline{W}$. For values of the reduced energy variable $x' = 2\epsilon/\sqrt{q^2}$ which belong to the central, region, two classes of behavior for $\overline{W}$ are discussed in the limit $q^2 \rightarrow \infty$: (i) singular and (ii) non-singular. A statistical model of class (ii) is emphasized for which the growth $\bar{n} \sim 2b^{-1}(2p_0 - 1)\ln q^2$ is possible, where $b = 3\{\zeta(4)/\zeta(3)\}$ and the exclusive form factor $F(q^2) \sim (q^2)^{-p_0}$ with $p_0 > \frac{1}{2}$. Amplitude $\overline{W}$ is specified in terms of a Bose–Einstein distribution in the variable $b\xi$, where $\xi \equiv x'/\bar{x}'$. The total annihilation cross section $\sigma \sim \sigma_{pt}/(\ln q^2)^{1+\delta}$, where $\sigma_{pt} = \pi\alpha^2/3q^2$ and $\delta > 0$, which leads to a convergent renormalization Z_3^{hadron}. A concrete model emerges for the excited hadronic constituents of the time-like photon ("partons") in which a pointlike property of the constituents is characterized by particle spatial dimensions being measured in units of the small de Broglie wavelength (in the c.m.s. of the e^+e^--collision). (auth)

51671 FINITE-ENERGY SUM RULES AND LIGHT-CONE COMMUTATORS. Mazzanti, P.; Venturi, G. (INFN, Bologna. Univ., Bologna). Nucl. Phys.; B45: No. 1, 143-56(1972).

Finite-energy sum rules for the imaginary part of a current (weak or electromagnetic) proton scattering amplitude are related to the light-cone commutator of the currents. The different contributions to the sum rules are examined in detail with particular emphasis on the contribution of disconnected states. The relative importance of the diverse contributions as expected on the basis of the Regge pole model is exhibited. The restrictions on the contribution of disconnected states for the validity of the Dashen, Gell Mann, Fubini sum rule in the algebras of currents and gauge fields are given. The finite-energy sum rules for the deep inelastic structure functions are then related to the parameters appearing in the Gell–Mann, Fritzsch light-cone algebra and the consequences discussed. (auth)

51672 PARTIALLY CONSERVED AXIAL-VECTOR CURRENT AND DEEP-INELASTIC ELECTRON SCATTERING. Yang, T. C. (Univ. of California, San Diego, La Jolla). Phys. Lett.; 41B: No. 1, 73-7(4 Sep 1972).

Using soft pion method, it is shown that the structure function $F_L^{e\pi \rightarrow e+anything}(\omega)\,|m_\pi^2 = 0 = 0$. With the aid of factorization of single Regge exchange, it follows that $F_L^{eN \rightarrow e+anything}(\omega) = 0$ for ω where Pomeron contribution dominates. (auth)

51673 t AND q^2 DEPENDENCE OF THE REACTION $e + p \rightarrow e + p + X$ (ANYTHING). Phan Xuan Yem (Institut de Physique Nucleaire, Paris). Phys. Lett.; 41B: No. 1, 67-72(4 Sep 1972).

The triple-Regge formalism is applied to the reaction $e + p \rightarrow e + p$ + anything. If a correct expression for the crossed channel $\cos\theta$ is used in the Regge expansion of the amplitude, the slope of $d\sigma/dt$ is produced, its flattening (when virtual photon mass $|q^2|$ increases) is explained, and the scaling both à la Bjorken and à la Feynman is obtained. The Pomeranchuk residue for the total photoabsorption cross section is predicted to have a dip around $|q^2| = 0.1\ (GeV/c)^2$. (auth)

51674 LEPTON AND QUARK SYMMETRY IN WEAK AND ELECTROMAGNETIC INTERACTIONS. Yang, T. C. (Univ. of California, San Diego, La Jolla). Phys. Lett.; 41B: No. 1, 62-6 (4 Sep 1972).

A three-quark model motivated by lepton-quark analogy is discussed. An advantage of this model is that there is no hypercharge-changing neutral current, but Cabibbo suppression has to be explained by dynamical reason. (auth)

51675 CONSERVATION CONSTRAINTS FOR e^+e^- ANNIHILATION AND ELECTROPRODUCTION. Etim, E. (Univ., Naples); Srivastava, Y. Phys. Lett.; 41B: No. 1, 59-61(4 Sep 1972).

Some consequences of energy-momentum conservation for hadron production in e^+e^- annihilation and electroproduction are investigated. It is shown that for annihilation the scaling results for the distribution function agree exactly with naive dimensional counting, whereas for electroproduction a different function scales due to the presence of a dimensional parameter in the form of $p_\perp$ cutoff. In addition, support is given for factorization and symmetry properties of the electroproduction distribution function. (L.B.S.)

51676 FIXED ANGLE DISPERSION RELATIONS AND t-CHANNEL CONTRIBUTION IN PHOTO-PION PRODUCTION. Dutta-Roy, B.; Mallik, S.; Roy, S. R. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys.; B45: No. 1, 61-70(1972).

A method is proposed for evaluation of the contribution of t-channel singularities for the photon-pion production process on the basis of dispersion relations for invariant amplitudes in the s-plane at fixed angle ($\cos\theta = \pm 1$). These dispersion relations are studied in the approximation scheme of retaining only the contributions from exchanges at low energy, viz., N, N*(1237) in the s- and u-channels and π, ρ, ω and A_1 in the t-channel. It is shown that the dispersion relations require more accurate evaluation in general than what the above approximation scheme can provide in order that the information obtained about the t-channel be reliable. (auth)

51677 EFFECT OF INELASTIC SCATTERING ON THE DETERMINATION OF UNSTABLE PARTICLE CROSS SECTIONS. Rogers, C.; Wilkin, C. (University Coll., London). Nucl. Phys.; B45: No. 1, 47-60(1972).

The coupling of an unstable particle to the continuum can influence the determination of its cross section off a nucleon based on coherent production on nuclei. This is investigated in a very simple model. It is pointed out that information, complementary to that obtained from forward production rates off a variety of nuclei, may be deduced from a production angular distribution off a light nucleus. (auth)

51678 TESTS OF THE $\Delta I \leq 1$ RULE IN BACKWARD PHOTOPRODUCTION PROCESSES. Field, J. H. (Rutherford Lab., Chilton, Eng.). Nucl. Phys.; B45: No. 1, 88-92(1972).

Further experimental tests of the recently reported $\gamma(I = 2)N\Delta$ coupling are considered. Two model independent tests of the $\Delta I \leq 1$ rule which should be particularly sensitive to the existence of the above coupling are given for backward photoproduction processes. They are 1. $\sigma(\Delta^+M^0) = \sigma(\Delta^0M^0)$, 2. $3\{\sigma(\Delta^+\pi^-) - \sigma(\Delta^0\pi^+)\} + 3\{\sigma(\Delta^+\pi^0) - \sigma(\Delta^0\pi^0)\} = \{\sigma(\Delta^{++}\pi^-) - \sigma(\Delta^-\pi^+)\}$, where M^0 is any $I = 0$ meson. (auth)

51679 CHERENKOV AND TRANSITION RADIATION IN SPACE–TIME PERIODIC MEDIA. Elachi, Charles (Jet Propulsion Lab., Pasadena, Calif. California Inst. of Tech., Pasadena). J. Appl. Phys.; 43: No. 9, 3719-23(Sep 1972).

The solution to the problem of determining the radiation emitted by a uniformly moving charged particle in a sinusoidally space-time periodic medium is obtained. The space-time periodicity can be considered as due to a strong pump wave and is expressed as a traveling-wave-type change in the dielectric constant or the plasma density. The solution covers also the limiting case of sinusoidally stratified media. The expression and spectrum of the radiated electromagnetic field are determined for different media: dielectric, isotropic and uniaxial plasma. Depending on the nature of the medium and the velocity of the particle, the radiated field is of the Cherenkov and/or transition type. The Brillouin diagram is used extensively in understanding and determining the nature, extent, and spectrum of the different modes of radiation, and a focusing effect is also studied. (auth)

51680 CONVERGENCE OF THE LOWEST-ORDER PHOTON-PHOTON SCATTERING AMPLITUDE IN THE GAUGE THEORIES. Fanchiotti, H.; Girotti, H. O.; Sirlin, A. (Univ. Nacional de La Plata). Lett. Nuovo Cim.; 4: No. 16, 826-8(19 Aug 1972).

It is shown from gauge invariance that the lowest-order diagram contributions to the physical $\gamma + \gamma \rightarrow \gamma + \gamma$ amplitude are convergent in the gauge theories. (J.F.P.)

51681 CONFORMAL INVARIANCE AND SCALING IN $e^+e^- \rightarrow h +$ ANYTHING. Roy, T.; Chowdhury, A. Roy; Banerjee, S. N.; Roychowdhury, R. K. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 4: No. 16, 829-30(19 Aug 1972).

The previously proposed idea that the two- and three-point functions in a conformal invariant theory can be easily constructed from a quark-type diagram and that they display the characteristic features of the short-distance behavior is used for analyzing the behavior of the structure functions W_1 and W_2 in the interaction $e^+ + e^- \rightarrow$ hadron + anything. Scaling in the structure functions is found. (J.F.P.)

51682 TWO-CLUSTER HADRON PRODUCTION IN DEEP INELASTIC e-p SCATTERING. Akiba, T. (Tohoku Univ., Sendai, Japan); Kasahara, T.; Ebata, T. Lett. Nuovo Cim.; 4: No. 16, 831-5(19 Aug 1972).

The multiplicity, momentum, and rapidity distributions of secondary hadrons produced in deep inelastic e + p interactions, particularly in the Bjorken limit $\omega = 2M\nu/Q^2$ fixed and ν, $Q^2 \rightarrow \infty$ are discussed. A model is proposed with account of Regge behavior of the structure functions, and it is emphasized that the model naturally leads to the scaling Regge form assumed previously. The one-photon exchange part of electroproduction only is considered (virtual photon interactions with protons to produce hadrons). (J.F.P.)

51683 CRITICAL COMMENT ON THE NONEXISTENCE OF THE CHARGE SUPERSELECTION RULE. Yoshihuku, Yasuo (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2085-9 (Jun 1972).

Aharonov and Susskind denied the concept of the superselection rules, and suggested the experimental feasibility of measuring interference between states with different charges. Their reasoning is shown to be incorrect. (auth)

51684 EFFECTIVE MASS AND CORRELATION LENGTH OF NUCLEON CONSTITUENTS. Vinciarelli, P. (Univ. of Maryland, College Park). Lett. Nuovo Cim.; 4: No. 16, 905-9(19 Aug 1972).

The question of the identification of partons with quarks for the nucleon structure is discussed in connection with the rapid reaching of the scaling regime for electroproduction structure functions. Using a field theory model an attempt is made to attach a direct physical meaning to the values of the energy and virtual-photon mass parameters which set the boundary of the scaling region. The description of the nucleon is that of a uniform sea of constituents, valence quarks, quark—antiquark pairs, etc. of small effective mass. The radius of the repulsive core is the quark correlation length. (J.F.P.)

51685 ELECTROMAGNETIC FORM FACTORS BASED ON THE THEORY OF MEROMORPHIC FUNCTIONS. Kobayashi, Masanori (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2044-54(Jun 1972).

The electromagnetic form factors (EMFF) are investigated by taking into account an infinite set of vector mesons which appear on the daughter trajectories. A general form of EMFF follows from the Hadamard theorem on a meromorphic function of order ρ. The Veneziano type EMFF is a meromorphic function of order one. It is shown that physically acceptable orders are either $\frac{1}{2} \leq \rho \leq 1$ or $\rho = 0$. Asymptotic n-power (n: integer) behavior is possible only if $\rho = 0$. (auth)

51686 REACTIONS $\gamma + \gamma \rightarrow$ PIONS BY EFFECTIVE LAGRANGIAN MODEL. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1947-9(Jun 1972).

The phenomenological effective Lagrangian for the annihilation of two photons into pions derived by Aviv, Hari Dass, and Sawyer and generalized by Yao is used to examine multiple pion production in the reactions $\gamma + \gamma \rightarrow$ pions. It is found that the cross section for $\gamma\gamma \rightarrow n\pi^+n\pi^-$ increases with s. The processes $\gamma\gamma \rightarrow n\pi^+n\pi^-\pi^0$ and $\gamma\gamma \rightarrow (2n + 1)\pi^0$ are also treated and it is concluded that the charged mode dominates over the neutral mode. (auth)

51687 CUT CONTRIBUTIONS TO THE NEUTRAL PION PHOTOPRODUCTION IN THE DUAL CUT MODEL. Kobayashi, Tetsuro; (Tokyo Metropolitan Univ.); Yamagishi, Kenji. Progr. Theor. Phys. (Kyoto); 47: No. 6, 1898-1909(Jun 1972).

It is pointed out that in the dual cut model there is a possibility of cut dominance over the pole under the assumption of the generalized factorizability conditions introduced here. The energy dependence of differential cross sections for neutral pion photoproduction is successfully explained in terms of cut amplitudes if they satisfy these conditions. Some remarks are briefly given on the conspiracy condition in connection with pion exchange processes. (auth)

51688 NEUTRAL-MESON PHOTOPRODUCTION AND RELATED VECTOR-MESON PRODUCTION. Alonso, J. L.; Gislen, L.; Tran Thanh Van, J. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Lett. Nuovo Cim.; 4: No. 11, 475-82(15 Jul 1972).

It is shown that a good description of $\gamma p \rightarrow \pi^0 p$, $\gamma n \rightarrow \pi^0 n$, $\gamma p \rightarrow \eta p$, and $\pi^0 p \rightarrow \zeta^0 p$ can be obtained in the framework of conventional Regge pole theory with nonsense-wrong-signature zeros and absorption. Density matrix elements and differential cross sections are well described with a small number of parameters. (L.B.S.)

51689 EMPIRICAL MASS FORMULA FOR MESONS. I. Nakamura, Hiroshi (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2150-3(Jun 1972).

An empirical mass formula for mesons is proposed, which can be related to quantum numbers by a dynamical mechanism. (L.B.S.)

51690 FIXED POLES IN COMPTON AMPLITUDES AND BOUND-STATE NATURE OF THE PHYSICAL NUCLEON. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Nucl. Phys.; B45: No. 2, 449-60(1972).

High-energy asymptotic behavior of the Compton scattering amplitudes is investigated in the bound-state model of Drell and Lee. It is shown that the bound-state nature of the physical nucleon together with local electromagnetic interactions leads to the existence of a right-signatured fixed pole at J = 0 with a residue function being a simple polynominal in virtual photon mass squared. Some consequences of this feature are discussed. (auth)

51691 COINCIDENCE π^0 ELECTROPRODUCTION IN THE SECOND RESONANCE REGION. Shuttleworth, W. J. (Univ. of Manchester, Eng.); Sofair, A.; Siddle, R.; (and others). Nucl. Phys.; B45: No. 2, 428-48(1972).

The reaction $e^- + p \rightarrow e^- + p + \pi^0$ was studied in the region of the second pion nucleon resonance. Two sets of data were taken and analysed at nominal values of the squared four momentum transfer to the pion nucleon system of 0.4 and 0.6 $(\mathrm{GeV}/c)^2$. A phenomenological interpretation of the data is presented. The results are compared with the predictions of fixed-t dispersion relation calculations and with the symmetric quark model. (auth)

51692 ENERGY-INDEPENDENT MULTIPOLE ANALYSIS OF π^0, π^+, AND π^- PHOTOPRODUCTION IN THE FIRST RESONANCE REGION. Pfeil, W.; Schwela, D. (Univ., Bonn). Nucl. Phys.; B45: No. 2, 379-96(1972).

Extending the previous work on a multipole analysis of π^0 and π^+ photoproduction, the results of an analysis of π^0, π^+ and π^- photoproduction are reported, using the very recent and accurate data of the π^-/π^+ ratio measured at Bonn. The analysis also uses the most recent πN phase shifts from the CERN analysis. The results are compared to two dispersion theoretic calculations. Discrepancies between theory and this analysis occur in particular for $M^{3/2}_{1-}$, for $M^{3/2}_{1+}$, E^0_{0+} and $M^{1/2}_{1+}$ while the other multipoles agree more or less with at least one calculation. All data are described satisfactorily without inclusion of an isotensor term in the electromagnetic current. (auth)

51693 MULTIPOLE ANALYSIS OF PION PHOTOPRODUCTION ON PROTONS NEAR P_{33}(1236) RESONANCE. Aleksandrov, Yu. M. (Lebedev Physical Inst., Moscow); Grushin, V. F.; Leikin, E. M.; Rotvain, A. Ya. Nucl. Phys.; B45: No. 2, 589-607 (1972).

The results of an energy-independent multipole analysis of pion photoproduction on protons are presented for the region of the P_{33} resonance. The analysis includes the phenomenological fitting of the experimental data by the linear model. The channel amplitudes of the $\gamma p \rightarrow n\pi^+$ process were obtained without using the Watson theorem and the isospin amplitudes of the $\gamma p \rightarrow n\pi^+$ and $\gamma p \rightarrow p\pi^0$ processes were obtained using the πN phase shifts. All the results are discussed and compared with the theoretical predictions. From the channel amplitudes obtained an attempt was made to evaluate the phases of M^3_{1+}. (auth)

51694 ELECTRODYNAMICS OF DUAL-CHARGED PARTICLES. Tarkhanyan, R. G. Dokl. Akad. Nauk Arm. SSR; 53: No. 3, 156-61(1971). (In Russian)

The problem of the magnetic charge was examined in connection with the hypothesis on the existence of dual-charged particles possessing both electric and magnetic charge. On the principle of least influence, a system of equations was obtained which complements the Maxwell–Lorentz equations for dual-charged particles. These equations offer some contrast to the Dirac monopole system, and after suitable treatment lead to macroscopic equations which had first been introduced by A. G. Iosif'ran (1970). (K.S.W.)

51695 SHIFTS OF ELECTRON BEAM POSITION DUE TO TOTAL REFLECTION AT A BARRIER. Miller, Stanley C. Jr.; Ashby, Neil (Univ. of Colorado, Boulder). Phys. Rev. Lett.; 29: No. 11, 740-3(11 Sep 1972).

Just as light beams can undergo position shifts when totally internally reflected, it is found that analogous shifts of an electron beam can occur upon total reflection at a potential barrier. A given shift corresponds to a spin polarization normal to the shift, and thus an initially unpolarized beam will be separated into two polarized beams. These shifts are comparable to the electron Compton wavelength times the number of multiple reflections. (auth)

51696 SINGLE-PARTICLE DISTRIBUTIONS IN DEEP INELASTIC ELECTROPRODUCTION. Pantin, C. F. A. (Univ. of Cambridge, Eng.). Nucl. Phys.; B46: No. 1, 205-31(1972).

The dual quark-parton model is used to investigate possible single-particle distributions in electroproduction. The particles are expected to be produced mainly in two kinematical regions, the target-nucleon fragmentation region and the virtual-photon fragmentation region. Using various dynamical assumptions, the relative number densities of the various types of detected hadron at high and low values of the scaling variable $\omega = -2\nu/q^2$ are predicted. At high ω, a connection is expected between the number-density distributions in electroproduction and hadron-hadron collisions; part of this connection may survive, at least approximately, for smaller values of ω. (auth)

51697 ELECTROMAGNETIC FORM FACTOR OF THE PROTON IN THE PARTON MODEL. Kitani, K. (Tokyo Inst. of Tech.). Lett. Nuovo Cim.; 4: No. 12, 555-60(22 Jul 1972).

A relation between the threshold behavior of the structure function νW_2 and the asymptotic behavior of the elastic form factor of the proton $F_1(Q)^2$ was previously derived from the parton model by Drell and Yan. The work of Drell–Yan is developed in the framework of the parton model by assuming the transverse-momentum distribution of the partons. In particular, an expression of $F_1(Q^2)$ is given in terms of $(\nu W_2^{ep}(x) - \nu W_2^{en}(x))/x$ and the mean-squared transverse momentum of the partons. (L. B.S.)

51698 PROCESS $\gamma\gamma \rightarrow \pi^+\pi^-$ IN THE QUARK MODEL. Gorczyca, B. (Jagellonian Univ., Krakow). Lett. Nuovo Cim.; 4: No. 12, 533-6(22 Jul 1972).

The creation of two charged pions by colliding real photons is analyzed in the framework of the additive quark model for photoproduction. It is found that by using the vector-meson dominance model and the additive quark model, the cross section for $\gamma\gamma \rightarrow \pi^+\pi^-$ can be expressed in terms of the experimentally known hadron cross sections. The result is shown to be in good agreement with that of the one-pion-exchange model for forward scattering. (L.B.S.)

51699 STATIC QUANTITIES IN WEINBERG'S MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Bardeen, W. A.; Gastmans, R.; Lautrup, B. (CERN, Geneva). Nucl. Phys.; B46: No. 1, 319-31(1972).

Within Weinberg's model of weak and electromagnetic interactions, the static quantities of the charged intermediate bosons are calculated. It is also proved that the neutrino charge remains zero in second order, and its charge radius is discussed. Finally, an unambiguous calculation of the muon g – 2 is presented. All calculations are done using the n dimensional regularization procedure of 't Hooft and Veltman. The results support the claim that Weinberg's model is renormalizable. (auth)

51700 TESTING TRIPLET MODELS. Suura, H. (Deutsches Elektron-Synchrotron, Hamburg); Walsh, T. F.; Young, Bing-lin. Lett. Nuovo Cim.; 4: No. 12, 505-10(22 Jul 1972).

Several tests which involve two-photon amplitudes in π^0, η', and η decay and $e^-e^- \rightarrow e^-e^-$ + hadrons interactions are used to distinguish between the Han–Nambu model and the Gell-Mann–Zweig model. (L.B.S.)

51701 BREMSSTRAHLUNG FROM LOW-ENERGY p–p SCATTERING. Dahlblom, T. K.; Green, A. M. (Univ. of Helsinki). Phys. Lett.; 41B: No. 1, 23-5(4 Sep 1972).

An additional term in the Feshbach–Yennie expansion for the p–p bremsstrahlung cross section is calculated. The effect of this is found to be small, and the final result is still in disagreement with some recent experiments and calculations. (auth)

51702 IMPROVED WEIZSACKER WILLIAMS METHOD AND PHOTOPRODUCTION OF LEPTON PAIRS. Kim, K. J.; Tsai, Y. S. (Stanford Univ., Calif.). Phys. Lett.; 40B: No. 6, 665-70 (21 Aug 1972).

An improved Weizsacker Williams method, which properly handles the atomic and nuclear form factors, is given. The method is applied to calculate the energy–angle distributions of the following photoproduced lepton pairs: an electron pair from an atom with screening effects and a muon pair from a nucleus with an elastic form factor. The numerical results are compared with the exact calculation using the Born approximation, and agreement is found to be better than a few percent. The numerical results of production of heavy leptons of masses m = 0.5, 1, 2, 4, and 6 GeV from photons of energies 20, 40, 100, and 200 GeV are also given. (auth)

51703 LIGHT-CONE LIMIT SEQUENCES IN ELECTROPRODUCTION. Baker, H. C. (Washington Univ., St. Louis). Phys. Rev., D; 6: No. 4, 1120-7(15 Aug 1972).

Calculating to a high order of approximation in the $\lambda\phi^3$ model, the possible connection between the deep Regge and deep scaling limits is investigated. A link between these limits is provided by fixed poles, even when canonical dimension is not conserved. (auth)

51704 SIMPLE BOUND-STATE MODEL OF THE PHYSICAL NUCLEON. Lee, T. D. (Columbia Univ., New York). Phys. Rev., D; 6: No. 4, 1110-20(15 Aug 1972).

A simple, but bona fide, local field-theoretic model is presented which illustrates the recently discussed bound-state concept of the physical nucleon. The scaling properties of W_1 and νW_2 functions in the deep-inelastic electron scattering are shown to be valid in the energy range in which the laboratory virtual-photon energy ν, in units of GeV, is larger than O(1) but less than $O(\exp(\epsilon^{-1}))$ where ϵ is a small, but nonzero, free parameter, assumed to be $\lesssim O(10^{-1})$. In this model, one of the constituents of the physical proton p is a local spin-½ charged field operator $\psi(x)$, and the usual "pointlike" assumption for the electromagnetic vertex of the constituent emerges simply as the standard minimal electromagnetic interaction in a local field theory. (auth)

51705 COMPOSITENESS AND LIGHT-CONE SINGULARITIES. Woo, C. H. (Univ., Sao Paulo, Brazil). Phys. Rev., D; 6: No. 4, 1127-30(15 Aug 1972).

Two arguments are offered that compositeness, with regular binding potentials, tends to "soften" short-distance singularities, and it is suggested that compositeness may reconcile Bjorken scaling with renormalizable strong interactions. (auth)

51706 HIGH-ENERGY SCATTERING OF A CHARGED VECTOR MESON IN A STATIC FIELD: SIMPLE EXPONENTIATION AND S-CHANNEL HELICITY CONSERVATION. Meng, Ta-chung (Univ., Berlin). Phys. Rev., D; 6: No. 4, 1169-77(15 Aug 1972).

It is shown that (a) the validity of s-channel helicity conservation and (b) the occurrence of simple exponentiation depend on the coupling between the vector meson and the external field. Both (a) and (b) can be realized in a theory where the charged vector meson has an anomalous magnetic moment (k = 1) and where the external charge distribution is not too singular. (auth)

51707 POSITIVITY RESTRICTIONS ON THE IMAGINARY PART OF THE FORWARD PHOTON–PHOTON SCATTERING AMPLITUDES. Kunszt, Z.; Ter-Antonyan, V. M. (Joint Inst. for Nuclear Research, Dubna). Lett. Nuovo Cim.; 4: No. 17, 940-2(26 Aug 1972).

Starting from the expansion in terms of eight invariant functions for the imaginary part of the forward photon–photon scattering amplitude, inequalities from positivity restrictions on this imaginary part are found. (J.F.P.)

51708 SOME TESTS OF THE ALGEBRA OF BILOCAL OPERTORS. Choudhury, D. K.; Murtaza, G. (Oxford Univ.). Lett. Nuovo Cim.; 4: No. 17, 943-9(26 Aug 1972).

Some tests are proposed for the connected part of the generalized algebra of the bilocal currents which include scalar, pseudoscalar, and tensor currents in addition to the ordinary vector and axial vector ones. The reactions $e + N \rightarrow e + \pi(\rho)\gamma$ + hadrons and $\nu(\overline{\nu}) + N \rightarrow \mu + \pi(\rho)\gamma$ + hadrons. The behavior of the structure tensor on the light cone is studied. (J.F.P.)

51709 MEASURABILITY OF THE SPIN OF FREE ELECTRONS. Farago, P. S. (Univ. of Edinburgh). Lett. Nuovo Cim.; 4: No. 17, 991-4(26 Aug 1972).

The validity of the statement that "... it is impossible to detect the angular momentum of free electrons by means of experiments based on the usual concepts of particle motion (trajectories of classical mechanics or rays of geometrical optics)" was previously discussed. The arguments pro and con are reviewed and criticized. (J.F.P.)

Weak

Refer also to abstract 51847.

51710 (BNL-16847) WEAK INTERACTIONS WITHOUT FORM FACTORS COLLIDING ELECTRON AND PROTON BEAMS. Tannenbaum, M. J. (Brookhaven National Lab., Upton, N. Y.). 13 Apr 1972. 12p. Dep. NTIS.

The reaction $e + p \rightarrow \nu + \mu^- + \overline{\nu} + p$ is pointed out as one which in principle can be studied with colliding electron proton beams and in which the effect of form factors is negligible. The production cross section for a heavy lepton in this same reaction is discussed. The production and decay of a heavy electron-like lepton $e^* \rightarrow e + \gamma$ is also suggested. (J.F.P.)

51711 NEUTRON-NEUTRON INTERACTION AND MUON CAPTURE BY DEUTERON. Truhlik, E. (Inst. of Nuclear Physics, Rez, Czech.). Nucl. Phys.; B45: No. 1, 303-17 (1972).

The reaction $\mu^- + d \rightarrow 2n + \nu_\mu$ is studied in the non-relativistic approximation using the Primakoff weak interaction Hamiltonian including relativistic corrections. The neutron-neutron interaction is treated (a) by the Omnès-Muskhelishvili equation, (b) in a potential model, (c) using the Bethe-Longmire procedure. Influence of D-state admixture in deuteron upon the transition rates and neutron spectrum is investigated. (auth)

51712 K_{14} DECAYS IN LIGHT CONE PHYSICS. Valenti, G. (New York Univ., N. Y.). Nucl. Phys.; B45: No. 1, 12-28(1972).

Light-cone techniques are applied to the study of the K_{14} decays. Scaling and Regge asymptotic behaviors are implemented to derive an expression for the deviation of the form factors from their chiral symmetry values. The result, in agreement with the present (rough) experimental data, is that only the form factor with a bad high-energy behavior receives sizeable correction from the light-cone. (auth)

51713 UPPER LIMIT ON THE NEUTRINO REST MASS. Cowsik, R.; McClelland, J. (Univ. of California, Berkeley). Phys. Rev. Lett.; 29: No. 10, 669-70(4 Sep 1972).

In order that the effect of gravitation of the thermal background neutrinos on the expansion of the universe not be too severe, their mass should be less than 8 eV/c^2. (auth)

51714 INDUCED NEUTRAL CURRENT IN UNIFIED MODELS OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Fujikawa, Kazuo (Univ. of Chicago); Lee, Benjamin W.; Sanda, A. I.; Treiman, S. B. Phys. Rev. Lett.; 29: No. 10, 682-4(4 Sep 1972).

Estimates of the amplitudes for the reactions $\nu_\mu + e \rightarrow \nu_\mu + e$ and $\nu + p \rightarrow \nu + p$ in the models of Georgi and Glashow, and of Lee, Prentki, and Zumino are presented. In these renormalizable models of weak and electromagnetic interactions, the above processes arise only in second order. The amplitudes are of the order $G_F \alpha$: They are neither enhanced nor suppressed. (auth)

51715 POLARIZATION EFFECTS IN NEUTRINO AND ANTINEUTRINO SCATTERING. II. THE QUARK PARTON MODEL. Gourdin, M. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France. Laboratoire de Physique Theorique et Hautes Energies, Paris). Nucl. Phys.; B45: No. 2, 485-98(1972).

Deep-inelastic scattering of neutrinos and antineutrinos from a polarized spin-$\frac{1}{2}$ target is studied in the theory of Fermi local interaction. The parallel-anti-parallel asymmetry is computed using the quark parton model and sum rules are discussed. (auth)

51716 POLARIZATION EFFECTS IN NEUTRINO AND ANTINEUTRINO SCATTERING. I. GENERAL RESULTS. Gourdin, M. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France. Laboratoire de Physique Theorique et Hautes Energies, Paris). Nucl. Phys.; B45: No. 2, 461-84(1972).

The consequence of locality in neutrino and antineutrino scattering on a polarized spin-$\frac{1}{2}$ target is studied. Structure functions are defined with their positivity constraints; the Adler test in the forward direction is discussed; sum rules for the polarization structure functions are derived. (auth)

51717 SUM RULE RELATING THE STRUCTURE FUNCTIONS OF LEPTON-NUCLEON SCATTERING AND THE D/F RATIO OF THE BARYON MASS SPLITTINGS. Riazuddin (Daresbury Nuclear Physics Lab., Eng.). Lett. Nuovo Cim.; 4: No. 16, 890-4 (19 Aug 1972).

A new sum rule is obtained which relates the D/F ratio of the baryon mass splittings to the structure functions of deep inelastic lepton-nucleon scattering. This sum rule is found to be consistent with the present experimental data. (J.F.P.)

51718 QUARK-PARTON MODEL AND CURRENT ALGEBRA. Genova, J. (State Univ. of New York, Stony Brook). Lett. Nuovo Cim.; 4: No. 16, 865-8(19 Aug 1972).

It is demonstrated that there is an equivalence between the quark-parton model and current algebra for lepton-nucleon scattering. (J.F.P.)

51719 LIGHT-CONE BEHAVIOR OF CURRENT COMMUTATORS AND KHURI AMPLITUDES. Boiti, M.; Pempinelli, F. (Univ., Lecce). Lett. Nuovo Cim.; 4: No. 15, 781-4(12 Aug 1972).

It is shown by means of the convolution theorem and the procedure of analytic continuation that the finite-energy sum rules of any momenta are connected to current commutators near the light cone. Also the relation between analytic properties of the Khuri amplitudes and light cone behavior of current commutators is examined. Spinless currents are considered. (J.F.P.)

51720 K^0 DECAYS, UNITARITY AND TCP. Stech, B. (CERN, Geneva). Nucl. Phys.; B46: No. 1, 100-8(1972).

The unitarity and TCP properties of weak decay amplitudes are discussed in an S-matrix approach. The K_S decay amplitudes are expressed in terms of the K_L amplitudes. (auth)

51721 WEAK MESONIC CURRENTS OF SECOND CLASS. Pietschmann, H.; Rupertsberger, H. (Univ., Vienna). Phys. Lett.; 40B: No. 6, 662-4(21 Aug 1972).

A weak current operator of second class which is constructed of mesons only has been suggested by Lipkin. If this current is extended to full SU_3, it contributes a second-class part to the axial-vector form factor of $\Sigma\Lambda$ decay. This is calculated with the aid of a standard Feynman cutoff to circumvent the logarithmic divergence. Present experiments restrict the coupling of such a current to the leptonic current to about one order of magnitude below the weak four fermi coupling. (auth)

51722 GREEN'S FUNCTIONS OF CURRENTS AND SCALING OF LEPTON-NUCLEON INELASTIC STRUCTURE FUNCTIONS. Etim, E. (Univ., Naples). Nuovo Cim., A; 10: No. 4, 689-702 (21 Aug 1972).

Guided by the rather suggestive form of the lepton-nucleon structure functions in the parton model a generalization of the parton approach to scaling is given in which the structure functions are statistically averaged temperature-dependent Green's functions of currents. It is shown that the observed scaling of the structure functions is related to and determined by properties of the hadronic mass spectrum in much the same way as scaling in many-body systems generally is related to the properties of these systems in the region of their critical points. (auth)

51723 MULTIPERIPHERAL MODEL OF μ-MESON INTERACTION. Levin, E. M.; Ryskin, M. G. (Inst. of Nuclear Physics, Leningrad). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 482-4(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 681-4(5 Jun 1972).

It is shown that even using a simplified multiperipheral model, a reasonable dependence of the amplitude on the paired energies leads at not too large a coupling constant to a constant cross section of reasonable value, and the decay of the resonances into pions makes it possible to obtain a multiplicity and perpendicular momenta close to the experimental ones. (J.F.P.)

51724 DESCRIPTION OF TEMPORAL EVOLUTION OF THE $K^0\overline{K}^0$ SYSTEM ON THE BASIS OF THE RELAXATION EQUATION FOR THE DENSITY MATRIX. Marinov, M. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 479-82(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 677-80(5 Jun 1972).

The time evolution of a beam of neutral K mesons passing through matter is described on the basis of the relaxation equation for the density matrix. (J.F.P.)

51725 SCALING AND THE INFINITE-MOMENTUM LIMIT. Keppel-Jones, M. A. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., D; 6: No. 4, 1140-8(15 Aug 1972).

The infinite-momentum derivation of the Adler sum rule for forward inelastic neutrino scattering under the assumptions of scaling and light-cone dominance of the scaling limit is considered. Assuming a perfectly general form for the equal-time current commutators, it is found that several nonvanishing terms are neglected in the infinite-momentum limit; these terms can be expressed as integrals over the scaling variable ω of the Bjorken scaling-limit functions $F_i(\omega)$. The Adler sum rule, with an indeterminate constant on the right-hand side, is shown to hold nevertheless. (auth)

51726 ADLER's SUM RULE FOR W_3 FROM TIME–SPACE ETC. Troost, W.; Verwaest, J. (Univ. of Louvain, Belgium). Lett. Nuovo Cim.; 4: No. 17, 932-4(26 Aug 1972).

It is shown that the W_2 and W_3 sum rules can be derived from space–time equal-time commutators supplemented with some moderate assumptions on Schwinger terms and the validity of the infinite-momentum frame technique. Neutrino and antineutrino interactions with protons are discussed. (J.F.P.)

51727 THEORY OF UNIVERSAL WEAK INTERACTION OF LEPTONS. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna). Lett. Nuovo Cim.; 4: No. 17, 953-6(26 Aug 1972).

A new theory of leptonic weak interactions is proposed which is free from the deficiency that due to nonrenormalizable divergences it is nonuniversal. The principal idea is that the Lagrangian is invariant with respect to rotations and reflections in a four-dimensional isospace. Definite relations among the processes $\mu^- \rightarrow e^- + \bar{\nu} + \nu$, $\mu^- \rightarrow e^- + \nu + \bar{\nu}$, $\nu_e + e^- \rightarrow \nu_e + e^-$, $\nu_\mu + e^- \rightarrow \nu_\mu + e^-$, and $e^- + e^- \rightarrow 2\mu^-$ are predicted. The problem of higher-order corrections is considered in which the semi-leptonic form of the interaction is written. A nonvanishing vector coupling constant for the transition $\Sigma^- \rightarrow \Lambda + e^- + \bar{\nu}$ is predicted. (J.F.P.)

Strong (General)

Refer also to abstracts 51875 and 51930.

51728 (COO–2009-39) THEORETICAL PARTICLE PHYSICS. Progress Report, December 1, 1971–November 30, 1972. Chu, Shu-Yuan; Hendry, Archibald W.; Lichtenberg, Don B. (Indiana Univ., Bloomington. Dept. of Physics). 1972. Contract AT(11-1)-2009. 15p. Dep. NTIS.

A model to describe particle scattering at all angles in terms of amplitudes which vary smoothly in impact-parameter space was applied to pion-proton, kaon-proton, and proton-proton scattering. The calculations have agreed quite well with experiment at those intermediate and high energies where all-angle data are available. In the case of pion-proton scattering, the amplitudes were compared to those of a Regge model, and were found to differ from the Regge amplitudes only by a rotation in amplitude space. At very high energies, forward-angle proton-proton scattering were interpreted as arising from a long-range potential which could be of the Van der Waals type. Such a potential could arise if hadrons are composed of quarks with a 1/r potential. The mechanism of CP violation in the dyon model was considered. The consequences of two-component duality were investigated, and it was concluded that if the idea is correct, other as yet undiscovered meson-baryon resonances of hypercharge zero must exist. Also explored was a multichannel model of scattering to obtain estimates of absorptive corrections to the Born-approximation result. (auth)

51729 (ITEF–866) REGGE GRAPHIC SCHEME FOR ATTAINED NONULTRAHIGH ENERGIES. Ter-Martirosyan, K. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The sequential theory of high energy elementary particle interactions may be constructed on the basis of Regge bands and all branches connected with the combinations of several bands. This theory was based on the Regge graphical technique of Gribov, and possesses an elegant expanded form at ultrahigh energies and low limits of momentum. The problem of obtaining a judicious extrapolation of this theoretical scheme was examined in the attainable energy region E ~ 10 to 100 GeV. (K.S.W.)

51730 (JINR–E2-5813, pp 37-72) QUASIPOTENTIAL APPROACH IN QUANTUM FIELD THEORY AND MODELS OF HIGH-ENERGY HADRON INTERACTIONS. Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR).

From International school on high energy physics meeting; Varna, Bulgaria (13 Jun 1971).

In the lectures the quasipotential approach to the description of the high energy hadron scattering is developed. Some new models of elastic and inelastic hadron interactions at extremely high energies are discussed. (auth)

51731 (JINR–E2-6638) AUTOMODELITY IN STRONG INTERACTIONS. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. Dep. NTIS (U. S. Sales Only).

A method is proposed for studying the dynamics of strong interactions by means of generalized dimensional analysis and automodelity principle. (auth)

51732 ONE-PION EXCHANGE AND INCLUSIVE REACTIONS. Pelosi, V. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Lett. Nuovo Cim.; 4: No. 11, 502-4(15 Jul 1972).

Some implications of the OPE model description of the peripheral behavior of strong interactions at medium and high energies are presented for inclusive interactions. Two effects are introduced, namely a shrinkage when the nucleon is probed at a certain energy, and an absorption efficiency factor accounting for production processes. (L.B.S.)

51733 INCLUSIVE DISTRIBUTIONS IN THE DUAL-RESONANCE AND IN THE STATISTICAL BOOTSTRAP MODEL. Satz, H. (Univ. of Bielefeld, Ger.). Lett. Nuovo Cim.; 4: No. 16, 910-12(19 Aug 1972).

It is shown that the dual-resonance model as a specific dynamical description fits into the general statistical scheme proposed by the thermodynamic model. It was previously shown that both models lead to an exponential level degeneracy, the thermodynamic model through the statistical bootstrap condition, and the dual-resonance model as a consequence of factorisation. Single-particle distributions for the decay of a hadronic system into a particle plus anything and a mesonic state of zero total spin and charge decaying into a meson plus anything are considered. Fireballs, which are the basic constituents of the thermodynamic approach, are found using the dual-resonance model. (J.F.P.)

51734 ANALYTICAL SOLUTION OF THE STATISTICAL BOOTSTRAP MODEL. Nahm, W. (Univ., Bonn). Nucl. Phys.; B45: No. 2, 525-53(1972).

The bootstrap for the hadronic mass spectrum which has been proposed by Hagedorn and Frautschi is investigated. Its solutions are determined for different requirements on the similarity of the input and the output spectrum. Sum rules are derived which relate the asymptotic parameters of the spectrum, especially the maximal temperature, to its low mass part. The agreement with experiment is good, if exotics are excluded. (auth)

51735 MATTER AT ULTRAHIGH DENSITIES. Tati, Takao (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2107-16(Jun 1972).

It is argued that a model of hadronic matter, based on the theory of finite degree of freedom, has the possibility of giving a final state with a finite density and a finite pressure at the maximum compaction of matter. An equation of state of matter at ultrahigh densities is derived from our model. (auth)

51736 SUM-RULES DERIVED FROM CROSSING SYMMETRY APPLIED TO PARITAL WAVE AMPLITUDES IN MULTI-PARTICLE REACTIONS WITH ARBITRARY SPINS AND MASSES. Johannesson, N. (Univ. of Lund, Sweden). Nucl. Phys.; B45: No. 2, 608-20(1972).

Using crossing properties of spinor amplitudes sum rules are derived for partial wave helicity amplitudes in many-body reactions involving particles of arbitrary spins and masses. The sum rules relate a finite number of partial waves from different crossed channels in an unphysical—the so called Euclidian—region. (auth)

51737 SINGLE-PARTICLE SPECTRA AT FIXED ANGLE AND DUALITY. Baier, R. (CERN, Geneva). Nucl. Phys.; B45: No. 2, 499-511(1972).

A dual resonance amplitude with satellites is applied in order to study the inclusive reactions $a + b \rightarrow x +$ anything at high energies and at fixed c.m.s. angle of the produced particle. Comparing the asymptotic expansion in this deep inelastic region with the one in the triple-Regge region, it turns out that the contributions of the satellite terms can be expressed by a function which is the same, but which appears with different arguments, in both limits. On the basis of this relationship between small- and large-angle scattering, a dependence of the shapes of single-particle distributions at large angles on the quantum numbers of the channel $(a\bar{x})$ can be predicted. (auth)

51738 SOME APPLICATIONS OF RELATIVISTIC QUARK MODEL. Kobushkin, A. P.; Shelest, V. P. (Inst. of Theoretical Physics, Kiev). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 571-605(1972). (In Russian).

The review of the applications of the quasiindependent quark model for the construction of the current algebra and for high energy hadron—hadron scattering is given. (auth)

51739 HADRON REACTIONS AND URBARYON REARRANGEMENT. II. IMPACT PARAMETER REPRESENTATION OF RESONANCE CORRELATION. Ghoroku, Kazuo (Kyushu Univ., Fukuoka); Imachi, Masahiro; Otsuki, Shoichiro; Toyoda, Fumihiko. Progr. Theor. Phys. (Kyoto); 47: No. 6, 1958-73(Jun 1972).

The impact parameter (b) representation of the H-type (s-t dual) amplitude is discussed through a sum of direct channel resonances (Breit—Wigner form) by imposing generalized Ogawa's rule of a constant impact parameter $b_0(\simeq 1 \times 10^{-13}$ cm). This amplitude is shown to have a Breit—Wigner form in the b representation, $1/(b^2 - b_0^2 - i\epsilon')$. The H-type amplitude $f^H_{\Delta\lambda}(s,t)$ is found to be proportional to $iH^{(1)}_{\Delta\lambda}(b_0\sqrt{-t})$, where $H^{(1)}_{\Delta\lambda}$ is the first kind Hankel function and $\Delta\lambda$ denotes the s-channel helicity change. The Hankel function $H^{(1)}_{\Delta\lambda}$ has definite real and imaginary parts, just corresponding to "rotation phase". A physical interpretation of Re f^H from s-channel picture is given. The crossed channel amplitude $f^X_{\Delta\lambda}(s,t)$ of the X-type (t-u dual) is discussed in connection with the form of $f^H_{\Delta\lambda}(s,t)$. (auth)

51740 THEORY OF THE REACTIONS OF THE COMPOSITE PARTICLES. Machida, Shigeru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2015-39(Jun 1972).

Theory of the reactions of hadrons, assumed to be composed of urbaryons with the degree of freedom of the spatial motion as well as those of unitary spin and spin, is discussed. An integral equation is derived for the one-time Bethe—Salpeter (BS) amplitude, based on the observation that the knowledge of the BS amplitude with the same value of time variables for all constituent particles is sufficient to derive the S-matrix element and by introducing the modified interaction kernel. The equation is a Klein—Gordon type integral equation in the momentum space, whose interaction kernel is energy-dependent and nonlocal and is also shown to be complex normal in general. Dispersion relations for that kernel and properties of their eigenvalues are also discussed. Resonances are discussed on the basis of the expansion of the kernel and the resolvent by the eigenvalues and the eigenfunctions of the kernel. The S-matrix element is shown to obey a difference equation approximately. By generalizing this difference equation so as to satisfy the crossing symmetry and by solving the resulting simultaneous difference equations with a suitably chosen form of the eigenvalues, a generalization of the Veneziano or the Virasoro amplitude is obtained. The original Veneziano or Virasoro amplitude is obtained as a limit of the above function which corresponds to the case of the eigenvalues of the kernel being a linear function of the square of the total energy in the center-of-mass system. (auth)

51741 POSSIBLE INTERPRETATION OF THE NEW EVENT IN THE COSMIC RAY EXPERIMENT. II. Hayashi, Takemi; Kawai, Ei-ichiro; Matsuda, Masahisa; Ogawa, Shuzo; Shige-eda, Shinsei (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1998-2014(Jun 1972).

In a previous paper a new event observed by Niu and others in cosmic ray experiments was analyzed, and a reasonable interpretation of it on the basis of the new (modified) Nagoya model for urbaryons was presented. Anticipating the accumulation of such new events, a further study is given about the details of weak decay processes which were not fully developed in the previous work. (auth)

51742 SCATTERING AMPLITUDE IN THE UR-CITON SCHEME. Ishida, Shin; Otokozawa, Jun (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2117-32(Jun 1972).

An operator method in treating the internal system of a harmonic oscillator in the urciton scheme [which was proposed recently by one of the authors (S. I.) for unified treatment of hadrons] is developed to derive form factors, vertex functions and scattering amplitudes. Although the treatment is limited for the simplified system of a one-ur-citon-particle and an external particle, the method may be directly applicable to the actual problem. As a result, it is especially shown that the scattering amplitude gives Regge pole behavior in the high energy region. (auth)

51743 MULTI-POMERON SELECTION RULES. Lovelace, C. (Rutgers—The State Univ., New Brunswick, N. J.). Phys. Lett.; 40B: No. 5, 551-4(7 Aug 1972).

In dual loop models with spin $\frac{1}{2}$ partons: Gribov's triple pomeron vertex vanishes identically. Multipomeron cuts decouple from pions. The pomeron conserves s-channel helicity when there is no l-excitation, but not otherwise. The $\alpha p = 0$ tachyon cancels. All four are due just to the spin structure of the pomeron "current," and agree with experiment. (auth)

51744 ISOSPIN SUM RULES FOR INCLUSIVE CROSS-SECTIONS. Rotelli, P.; Suttorp, L. G. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett.; 40B: No. 5, 579-82(7 Aug 1972).

A systematic analysis of isospin sum rules is presented for the distribution functions of strong, electromagnetic and weak inclusive processes. The general expression for these sum rules is given and some new examples are presented. (auth)

51745 PIONIZATION STRUCTURE FUNCTION. Zakrzewski, W. J. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 40B: No. 6, 645-50(21 Aug 1972).

The properties of a pionization structure function are analyzed. By making some general assumptions about the analyticity structure of amplitudes describing inclusive processes (which are valid in a large class of models and are expected to be valid for the true amplitudes), a general form of this structure function is derived. (auth)

51746 DIFFRACTIVE DISSOCIATION OF COMPOSITE PARTICLES. Bialas, A. (Jagellonian Univ., Krakow); Czyz, W.; Kotanski, A. Nucl. Phys.; B46: No. 1, 109-30(1972).

A parton model for diffractive dissociation processes is proposed. It is assumed that the elastic diffractive scattering of partons off the target leads to diffractive excitation of the incident particle and/or the diffractive production of new particles. A prescription for calculating transition matrix elements is given and illustrated by several examples of strong and electromagnetic processes. Relation to: (a) one-particle exchange models, (b) vector dominance model, (c) Chou and Yang model and (d) QED calculations of Cheng and Wu is discussed. These models turn out to be special cases of our model. (auth)

51747 GRAPHICAL DUALITY AND THE ALGEBRA OF VERTEX STRENGTHS. Kantorovich, A. (Tel-Aviv Univ., Israel); Stumer, I.; Ne'eman, Y. Nucl. Phys.; B46: No. 1, 190-204(1972).

It is proved that the Regge exchange part of Im A(s,t) in graphical duality is given exactly by symmetric $[U(3) \times U(3)]_8$ "CHN" couplings. Adopting the physical picture implied by graphical duality thus requires the adjunction of a nineteenth operator in CHN, to represent the diffractive contribution. A Casimir operator is introduced which reproduces the Levin—Frankfurt ratio of $\sigma_{tot}(NN)$: $\sigma_{tot}(\pi N) \rightarrow 3:2$. The experimental situation is examined in that light. (auth)

51748 N-BODY INCLUSIVE REACTIONS IN THE VENEZIANO MODEL. Hoyer, P.; Lam, C. S. (Oxford Univ.). Nucl. Phys.; B46: No. 1, 253-74(1972).

The discontinuity of the Veneziano amplitude appropriate to N-particle inclusive reactions is studied. Factorization of the discontinuity in a general high-energy multi-cluster limit is shown. Explicit formulas for the vertex functions are given. (auth)

51749 STATISTICAL GENERALIZATION OF THE MULTIPERIPHERAL BOOTSTRAP. Giovannini, A. (Univ., Turin). Nuovo Cim., A; 10: No. 4, 713-22(21 Aug 1972).

The discussion of the multiperipheral bootstrap model in its one-dimensional version leads one to consider some experimental and theoretical inconsistencies, which are expected to be crucial at very high energies. A statistical generalization of the model is proposed; the new model allows one to separate the multiperipheral and diffractive contributions to the n-particle production cross sections. The general properties of the model are investigated. (auth)

51750 SUPERFLUIDITY OF HADRONIC MATTER. Mann, A.; Weiner, R. M. (Indiana Univ., Bloomington). Nuovo Cim., A; 10: No. 4, 625-40(21 Aug 1972).

The mesons in the nucleon are associated with a Bose system with an energy excitation spectrum $\epsilon(p)$, where p is the corresponding momentum. This spectrum can be investigated by studying the nucleon recoil in one-meson production processes. It turns out that $\lim_{p\to 0} (\epsilon/p) \neq 0$. This is the Landau criterion for superfluidity. From this it is inferred that hadronic matter is superfluid. Possible manifestations of this phenomenon in strong interactions are a bootstrap relation between the masses of mesonic and baryonic resonances, the shift of the Δ-resonance in nuclei, the existence of a maximum resonance mass equivalent to an ionization point, and the existence of a critical temperature of hadronic matter instead of a maximum temperature. (auth)

51751 INTERACTION OF EXTENDED PARTICLES. FORMULATION OF BREAKING AND CONNECTION OF STRINGS.

Goto, Tetsuo (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2090-2106(Jun 1972).

The interaction in the string model of hadrons is studied under the assumption that the interaction occurs through breaking and connection of strings. It is shown that its mathematical formulation is possible and a simple scattering amplitude can be calculated. Although the amplitude has not complete duality in general, the Veneziano amplitude can be obtained in the special limit where one of two strings produced in breaking process has infinitesimally small length. (auth)

51752 HADRON STRUCTURE AND THE PARTON–PARTON INTERACTION IN A PARTIAL BOOTSTRAP MODEL. Cooper, Fred; Schonberg, Edmond (Yeshiva Univ., New York). Phys. Rev., D; 6: No. 4, 1082-91(15 Aug 1972).

A model is presented where hadrons are infinitely composite objects made up of pointlike constituents (partons). The requirement that the hadron wave function be power-behaved determines the nature of the parton-parton interaction. In particular σ(parton-parton) ~ const at high energies. If this is implemented by vector-gluon exchange between partons, the following simple picture of electromagnetic form factors and large-angle hadron-hadron scattering arises: (a) The electromagnetic form factor F(t) has the same power behavior as the hadron wave function. (b) The large-angle scattering cross section is proportional to $|F(t)|^4$. (c) The effective interaction of the vector gluon with the composite hadron is described by the same form factor F(t) as the electromagnetic interaction of the hadron. (auth)

51753 GRIBOV'S TRIPLE-POMERANCHUKON VERTEX AND INCLUSIVE REACTIONS. Bronzan, J. B. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev. D; 6: No. 4, 1130-9(15 Aug 1972).

It is shown that in the nonplanar model of Gordon and of Mueller and Trueman the triple-Pomeranchukon vertices of Gribov's Reggeon calculus and inclusive reactions are identical in the forward direction. The zero of the forward vertex is therefore connected with the zero of Gribov's vertex, and the collision of the Pomeranchukon poles and cuts. A modification of the Reggeon unitary amplitudes of Gribov, Pomeranchuk, and Ter-Martirosyan is used to discuss inclusive reactions for $t \neq 0$. Like Goddard and White, it is found that the inclusive vertex vanishes linearly in t. However, disagreement is found with the argument of Goddard and White. (auth)

51754 CAN QUARKS BE KEPT INSIDE HADRONS? Johnson, K. (Stanford Univ., Calif.). Phys. Rev., D; 6: No. 4, 1101-10 (15 Aug 1972).

A self-consistent dynamical mechanism is suggested which appears to be compatible with conventional ideas about relativistic field theory, and which prevents the appearance of the quanta of the field in outgoing or incoming scattering states. A model calculation is provided which illustrates the mechanism. The model produces a spectrum of conventional hadron states which corresponds to an infinitely rising Regge trajectory. All states are physical. When SU(3) internal quantum numbers are included, it is argued that the mechanism is stable only if the physical states have zero triality. (auth)

51755 STUDY OF THE HYPOTHESIS OF THRESHOLD DOMINANCE IN A RENORMALIZED LINEAR σ MODEL. Wong, T. F. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., D; 6: No. 4, 1065-70(15 Aug 1972).

Li and Pagels's hypothesis of threshold dominance (h.t.d.) in a linear SU(2) × SU(2) σ model renormalized up to one loop. The exact inverse two-point functions (σ and π inverse propagators) at zero momentum transfer are calculated. These values are compared with that obtained by following the h.t.d. procedure. The threshold-dominance values show a sensitive dependence on the "cutoff," and the error ranges from 8% to 43%. (auth)

51756 DIAGONALIZATION OF INCLUSIVE SUM RULES AND INCLUSIVE BOOTSTRAP. Mak, Se-yuen; Tan, Chung-i (Brown Univ., Providence). Phys. Rev., D; 6: No. 4, 1059-65(15 Aug 1972).

The technique of multidimensional Laplace transforms is introduced under which the inclusive-like sum rules for discontinuities of multiparticle amplitudes can be diagonalized. The resulting equations are simple constraints on our generalized partial-wave amplitudes, and they can be used to impose unitarity conditions for bootstrap models. A simple example is given to illustrate the nonlinear nature of this "inclusive bootstrap" program. (auth)

51757 SPACE–TIME ANALYSIS OF HADRONIC INCLUSIVE REACTIONS. Bandelloni, G. (Univ., Genoa). Lett. Nuovo Cim.; 4: No. 17, 1019-23(26 Aug 1972).

The pionization and fragmentation regions of meson production in two-body inclusive strong interactions are studied by analyzing the short-distance and light-cone contributions qualitatively and by using the meson currents in the quark model. Wee-parton and angular distributions and sum rules are found. (J.F.P.)

Strong (Baryon No. = 0)

51758 (DESY–72/33) CHIRAL INVARIANCE AND EFFECTIVE RANGE EXPANSION FOR PION–PION SCATTERING. Lehmann, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jun 1972. 8p. Dep. NTIS (U. S. Sales Only).

The key to the problem of an effective range expansion lies in the observation that S-matrix elements remain finite if the pion mass is made to approach zero. Therefore, to obtain a simple description of low energy pion–pion scattering, it is analyzed in a chiral-invariant world where pions are massless. For this purpose the zero-mass approximation should not lead to serious errors except near threshold. The pion mass is reinstated in the final formulas when converting momenta into energies. (J.F.P.)

51759 (SLAC-PUB–1058) CURRENT PROBLEMS AND FUTURE DIRECTIONS IN MESON SPECTROSCOPY: THEORY. Gilman, Frederick J. (Stanford Linear Accelerator Center, Calif. National Accelerator Lab., Batavia, Ill.). Jun 1972. 18p. (CONF-720409–12). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

Some current problems and open questions connected with the subject of meson spectroscopy are discussed. Emphasis is put on some of the experiments which might be done to clarify these topics. (auth)

51760 DUAL-MODEL SPECTRUM ANALYSIS, USING VIRASORO-ALGEBRA REPRESENTATIONS. Frampton, P. H.; Nielson, H. B. (CERN, Geneva). Nucl. Phys.; B45: No. 1, 318-32 (1972).

The spectrum of states in the unit intercept Veneziano model is studied by noticing that there is exactly one physical state in each irreducible representation of the Virasoro algebra for spacelike momenta. The squared norms of the continued physical states are fully enumerated. A method of analytic continuation from the spacelike to the timelike domain is described. As an illustrative example of its usefulness, the lower limit of Del Guidice, Di Vecchia and Fubini for the number of positive squared norm physical states on mass shell is rederived; the states obtained in this way are of definite spin. (auth)

51761 UNITARITY, DUALITY, AND ABSORPTION: A GENERAL DISCUSSION AND A DEFINITE MODEL. Cohen-Tannoudji, G. (CEN de Saclay, Gif-sur-Yvette, France); Lacaze, R.; Henyey, F. S.; (and others). Nucl. Phys.; B45: No. 1, 109-42(1972).

The problem of incorporating unitarity effects into dual scattering amplitudes is studied. Possible forms and interpretations for amplitudes which have dual properties consistent with experimental data (including the fixed-t zero structure, the dominance of peripheral resonances, etc.) are discussed. A detailed physical interpretation, in terms of absorption effects, is provided at all energies. A specific model is presented which demonstrates that amplitudes of the desired kind do exist and that one can work with them. The model is studied in detail for spinless particles (e.g., $\pi\pi$ scattering). Apart from a few technical difficulties the resulting amplitude can be studied at all energies and angles and behaves in all aspects essentially as realistic scattering amplitudes (and data) are expected to behave. (auth)

51762 PARAMETRISING THE PION FORM FACTOR. Lyth, D. H. (Tel Aviv Univ., Israel). Nucl. Phys.; B45: No. 2, 512-24(1972).

Parametrisations of the $l = 1$ $\pi\pi$ phase shift and of the pion form factor given in a previous publication are discussed further, and particularly compared with those suggested by Gounaris and Sakurai. (auth)

51763 NEW TIGHT INEQUALITY FOR $\pi\pi$ SCATTERING. Grassberger, P. (Univ., Bonn.); Kuehnelt, H. Lett. Nuovo Cim.; 4: No. 16, 895-9(19 Aug 1972).

An improved version of a previous inequality, which was found to be restrictive, is presented for models of elastic $\pi + \pi$ scattering. The version given is $f_0'(0) < -\frac{1}{4}[2f_0(4) - f_0(0) - f_0(s) + \alpha(s)f_0'(s)]$ for $1.69 < s < 2.4$ and $\alpha(s)$ given. (J.F.P.)

51764 LOW ENERGY $\pi - \pi$ FINAL STATE INTERACTION IN THE VENEZIANO MODEL. Chiang, H. C.; Lee, T. Y.; Liu, J. O. (National Tsing Hua Univ., Hsinchu, Taiwan). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1950-7(Jun 1972).

Low energy $\pi-\pi$ interaction is studied in the Veneziano model. It is shown that the pure Veneziano model with ρ trajectory dominance can describe the I = 0, J = 0 low energy behavior of the $\pi-\pi$ system qualitatively. It predicts the existence of ϵ resonance which is considerably broader than the ρ resonance. The final state interaction effect characterized by two pion intermediate state is considered. It is concluded that the correction is small but in the correct direction for the energy region below ϵ mass. In the ϵ region it has the effect to produce a long shoulder which is favored by the present experimental data. (auth)

51765 INTEGRATED AND LOCAL ABSOLUTE BOUNDS FOR THE TWO PION ANNIHILATION OF $\bar{p}p$. Common, A. K. (Univ. of Kent, Canterbury, Eng.); Yndurain, F. J. Nucl. Phys.; B45: No. 2, 577-88(1972).

Integrated and local bounds for the cross section $\sigma_{\bar{p}p\to\pi^+\pi^-}$ are calculated. The bounds are fairly tight, and are even violated at low energy by some extrapolations of the experimental $\bar{p}p \to \pi^+\pi^-$ data. At high energies the bounds improve known asymptotic bounds for the same process. (auth)

51766 COMPATIBILITY BETWEEN CURRENT ALGEBRA AND UNITARITY CONSTRAINTS IN A LOW-ENERGY πK MODEL. Ader, J. P. (Univ., Bordeaux); Meyers, C.; Bonnier, B. Nucl. Phys.; B45: No. 2, 554-76(1972).

An attempt is made to describe the πK scattering amplitude, on and off mass-shell, in the low-energy region, using the requirements of analyticity and unitarity. A three variables crossing symmetric expansion at third order is considered, allowing for the unitarity cuts and allowing one particle to go off its mass-shell. Threshold unitarity is required on-shell and off-shell for one pion or one kaon extrapolated between its physical mass and the Adler's point, thus fixing all the parameters of our model in terms of the two S-wave scattering lengths $a_0^{1/2}$ and $a_0^{3/2}$. Then elastic unitarity is enforced on-shell by a minimization procedure, giving the domains of best unitarity in the $(a_0^{1/2}, a_0^{3/2})$ plane. Finally some current algebra constraints or a dynamical input provided by the existence of the K* are used to restrict these domains. In the π-extrapolation approach, selected solutions are in agreement with the Adler's condition, give a reasonable value of the π-decay constant f_π and satisfy conveniently unitarity and positivity. Moreover their scattering lengths are close to the current algebra results. The predicted phase shifts agree well with the experimental data. Conclusions from the K-extrapolation study, though less accurate, are in agreement with the pion extrapolation ones. (auth)

51767 SCATTERING AMPLITUDE EXPANSION IN THE TRANSVERSE-MOMENTUM PLANE. Paccanoni, F. (Univ. of Padua. Istituto Nazionale di Fisica Nucleare, Padua). Lett. Nuovo Cim.; 4: No. 15, 771-6(12 Aug 1972).

An S_2 expansion of the scattering amplitude whose limits of applicability are beyond potential theory is discussed. The derivation is based on a particular choice of the kinematical variables. The elastic scattering in the cm frame of two spinless particles is considered. (J.F.P.)

51768 SCATTERING OF A SYSTEM OF RESONANCE MIXTURES, EXACT FORMALISM. Gien, T. T. (Memorial Univ. of Newfoundland, St. John's). Nuovo Cim., A; 10: No. 4, 799-817(21 Aug 1972).

The derivation of the formalism for an overlapping resonance system based on the Wigner–Weisskopf approximation is hardly justifiable when applied to a system involving a strong decay such as $\rho-\omega$. It is, therefore, intended to develop the formalism for an overlapping resonance scattering in an exact way, namely when no such an approximation needs to be considered. All the expressions of interest are obtained, including the Bell–Steinberger sum rule, which remain unchanged in the general case compared to those found previously when the Wigner–Weisskopf approximation is used. Consequently, the formalism for an overlapping resonance system remains valid even in the case of a strong decay. (auth)

51769 QUASILINEAR MODELS OF LOW-ENERGY PION–PION SCATTERING AND THE RIGOROUS CONSTRAINTS BELOW THRESHOLD. Piguet, O.; Wanders, G. (Univ., Lausanne). Nucl. Phys.; B46: No. 1, 295-318(1972).

Models of S- and P-wave pion-pion scattering are investigated. Their amplitudes satisfy elastic unitarity and are quasilinear in the sense that they are nearly linear functions of s in the unphysical interval $0 < s < 4m_\pi^2$. The models are submitted to rigorous constraints holding in this interval and resulting from crossing symmetry and positivity of the absorptive parts. If one imposes only the linear parts of the amplitudes as input, these constraints have nearly no restrictive effect. However, if the ρ-meson is required and if the shape of the I = 2 S-wave is fixed, the I = 0 S-wave is strongly restricted in a small but finite domain above threshold (280 MeV < $m_{\pi\pi} \lesssim$ 450 MeV). In the ρ-region, the limitations resulting from the constraints are no more significant. It is concluded that the rigorous constraints below threshold have a physical relevance which is restricted to a small energy interval above threshold. (auth)

51770 PHYSICAL STATES AND POMERON POLES IN THE DUAL PION MODEL. Schwarz, J. H. (Princeton Univ., N. J.). Nucl. Phys.; B46: No. 1, 61-74(1972).

The methods recently developed by Brower for proving the no-ghost theorem for the Veneziano model with $\alpha(0) = 1$ are applied to the dual pion model. Operators are constructed that generate all the physical states and it is proved that there are no ghosts for space-time dimensionality $d \leq 10$. In the critical dimension $d = 10$ it is found that the pomeron singularities arising from nonplanar loops are simple poles. A new fully symmetrical model (a sort of "pionic" version of the Shapiro-Virasoro model) is formulated and conjectured to correspond to the multi-pomeron amplitudes. (auth)

51771 NEW CONSTRAINTS ON THE PION ELECTROMAGNETIC FORM FACTOR AND THE CHOU–YANG MODEL. Ajduk, Z. (CERN, Geneva); Lukaszuk, L. Nucl. Phys.; B46: No. 1, 131-40(1972).

New, strong restrictions on the pion charge radius and pion electromagnetic form factor F(t) in the spacelike region, as well as on the asymptotic $\pi\pi$ scattering, are derived using the Chou-Yang model for spacelike F(t) combined with experimental data on $|F(t)|$ in the timelike region and with rather weak analyticity assumptions for the pion form factor. (auth)

51772 PHYSICAL-REGION SUM RULES FOR PION–PION SCATTERING. Dilley, James P. (Univ. of Colorado, Boulder); Teshima, R. Nucl. Phys.; B46: No. 1, 275-82(1972).

Physical-region pion-pion scattering sum rules derived from crossing symmetry and Regge high-energy behavior are examined using estimates from experimental data. The I = 1 sum rule is well satisfied and is shown to give important constraints on amplitudes in the physical region. The I = 2 sum rule, though a priori plausible, is found to be either invalid or, if valid, to give no useful constraints. (auth)

51773 UPPER BOUND FOR THE PION–PION s-WAVE AMPLITUDE. Dita, P. (Inst. of Physics, Bucharest). Nuovo Cim., A; 10: No. 4, 753-8(21 Aug 1972).

An upper bound on the s partial-wave amplitude for $\pi^0\pi^0$ scattering involving only the pion mass is given in the unphysical region $0 < s < 4$. (auth)

51774 STATISTICAL APPROACH TO THE CALCULATION OF RESONANT WIDTH AND MULTIPLICITY IN DUAL MODELS. Gorenshtein, M. I.; Zinov'ev, G. M.; Makarov, V. I.; Miranskii, V. A.; Shelest, V. P. (Inst. of Theoretical Physics, Kiev). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 487-9(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 686-9(5 Jun 1972).

The methods of statistical mechanics are used to study the total and partial widths of the resonances and the multiplicity of pion production in the dual resonance model. (J.F.P.)

51775 CALCULATIONS OF THE POMERANCHUK RESIDUE AT t = 0 USING INTERMEDIATE-ENERGY BOOTSTRAP DYNAMICS BASED ON AVERAGE NONLINEAR DUALITY. Balazs, Louis A. P. (Purdue Univ., Lafayette, Ind.). Phys. Rev., D; 6: No. 4, 1038-47(15 Aug 1972).

By imposing nonlinear forms of average duality at intermediate energies it is possible to obtain simple inhomogeneous relations between Regge residues. This reopens the possibility of using duality to make genuine bootstrap calculations. Two different forms of nonlinear duality are considered, both of which are applied to $\pi\pi$ scattering, in combination with the usual linear duality. The first (Type A) asserts that, if σ^c is the cross section for a particular reaction c, $\sigma^c_{\text{resonance}} = \sigma^c_{\text{Regge}}$, when averaged appropriately over one or more resonances. Applying it at the g resonance, a total g width of 123 MeV is obtained, in agreement with experiment. The second (Type B) uses the optical theorem and states that $A_{\text{Regge}} = \Sigma_c K\sigma^c_{\text{Regge}}$ on the average, where A is the forward $\pi\pi$ absorptive part and K is a kinematic factor. The sum is over all reactions c making up the total cross section, which is taken to be $\pi\pi \to \pi\pi$, $\pi\pi \to \rho\rho$, $\pi\pi \to \rho\epsilon$, and $\pi\pi \to \epsilon\epsilon$ below the 3ρ threshold. The last three are treated in a model-independent way, assuming only semilocal linear duality and the dominance of I = 1 exchanges, such as the π and A_2. Calculations are then made in which Pomeranchuk exchange is included in A_{Regge} and different energy intervals are selected for the averaging procedure. For example, a semilocal calculation around the g resonance gives a ρ Regge residue corresponding to a ρ-meson width of 133 MeV, and a Pomeranchuk residue corresponding to an asymptotic σ_{tot} = 13.5 mb; the only input parameters are the resonance masses, which can be fixed by using the partial conservation of axial-vector current. (auth)

51776 CURRENT CONSERVATION, THE LORENTZ CONDITION AND WEAK GAUGE INVARIANCE IN THE DESCRIPTION OF MASSIVE AND MASSLESS VECTOR PARTICLES. McKenzie, N. C. (Kyoto Univ.). Lett. Nuovo Cim.; 4: No. 17, 957-61(26 Aug 1972).

It is shown how a study of the polarization vectors for a spin-1 boson as a function of the mass of the particle can yield insight into the relation between the constraints imposed by current conservation, the Lorentz condition, and weak gauge invariance for massive and massless particles. The continuation to the zero-mass limit is also shown. The process $\rho + \pi \to \sigma + \pi$ is treated. (J.F.P.)

51777 REGGE EIKONAL MODEL CALCULATION FOR THE REACTION $\bar{p}p \to \Delta^{++}(1236)\Delta^{++}(1236)$. Angelini, C.; Lariccia, P. (Univ., Pisa). Lett. Nuovo Cim.; 4: No. 17, 965-8(26 Aug 1972).

The results of a calculation of the differential cross sections and the spin density matrix for the $\Delta(1236)$ in the reaction $\bar{p} + p \to \Delta^{++}(1236) + \Delta^{++}(1236)$ at 12 GeV/c are presented. The model proposed by Arnold (Phys. Rev. 153, 1523(1967), which includes Regge cuts, is used. It is confirmed that pion and pomeron exchange effectively accounts for the reaction. (J.F.P.)

51778 COMPARISON BETWEEN THE DETERMINANTAL METHOD AND PADE APPROXIMANTS FOR THE S-MATRIX. Corbella, O. D. (Universidad Nacional de Rosario, Rio de Janeiro); Mignaco, J. A. Lett. Nuovo Cim.; 4: No. 17, 978-80 (26 Aug 1972).

It is shown that the determinantal and Pade approximants methods for the S-matrix for pion–pion scattering are different though sharing some common features. The comparison of numerical results shows an inconsistency for these interactions. (J.F.P.)

Strong (Baryon No. = 1)

Refer also to abstract 51857.

51779 (INP–753) MULTIPLICITY DISTRIBUTIONS AND THE MULTIPERIPHERAL MODEL. Kisielewska, D.; Loskiewicz, J. (Institute of Nuclear Physics, Krakow (Poland)). Mar 1972. 26p. Dep. NTIS (U. S. Sales Only).

The experimental data on multiplicity distributions in π^-p interactions are compared with Multi-Regge Model (MRM) predictions. It is shown that the versions of MRM with single pole as leading singularity do not describe experimental data correctly. In most cases the high multiplicity tail is underestimated by the model. This may mean that some additional mechanism is present. In such a case the use of energy-independent isospin factors seems unjustified. (auth)

51780 (JINR–P1-6521) PARTIAL-WAVE ANALYSIS OF THE $\pi N \to \pi\pi N$ REACTIONS NEAR THE THRESHOLD OF Δ_{1236}-RESONANCE PRODUCTION WITH THE ACCOUNT OF THE TRIANGULAR GRAPH CONTRIBUTIONS. I. MODEL DESCRIPTION. Bunyatov, S. A.; Kurbatov, V. S.; Likhoded, A. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

A model is considered which allows the phenomenological analysis of all the five channels of the $\pi N \to \pi\pi N$ reaction from threshold up to 500 MeV to be performed. Besides the Δ_{1236} isobar and $\sigma(750)$ meson in the final state the contribution of the triangular graph is taken into account for the description of all the reaction channels, especially near the threshold of Δ_{1236}-resonance production in the energy range of (350 to 450) MeV. Inclusion of the contribution of the triangular graph allows one to estimate the $\pi\pi$ scattering length a_0. In the model the S_{11}, P_{11}, P_{13}, D_{13}, S_{13}, P_{31}, D_{33} states are taken into account. (auth)

51781 (ORO–3992-88) STRONG CENTRAL ABSORPTION PRESCRIPTION VERSUS THE Σ-PRODUCTION DATA. Chiu, C. B.; Ugaz, E. (Texas Univ., Austin. Center for Particle Theory). 12 Jul 1972. Contract AT(40-1)-3992. 11p. (CPT–148). Dep. NTIS.

Experimental evidence is presented for a strong central absorption in the exchange amplitude when the direct channel is associated with nonexotic quark states, and the general absorption pattern in high energy two-body collisions is discussed.

51782 (SLAC-PUB–948) ELECTROMAGNETIC INTERACTIONS WITH EMPHASIS ON COLLIDING RINGS, PARTONS, AND THE LIGHT CONE. Drell, S. D. (Stanford Linear Accelerator Center, Calif.). 1971. 26p. (CONF-710609–15). Dep. NTIS.

From International conference on elementary particles; Amsterdam, Netherlands (30 Jun 1971).

The structure of the proton is discussed using $e^+ + e^-$ interactions in colliding beams, partons and the light cone, and various models for fitting the data. (J.F.P.)

51783 PROTON IN TERMS OF ULTIMATES IN PHYSICS. Ayub, S. M. J. Natur. Sci. Math.; 11: No. 2, 113-19(Oct 1971).

The internal structure of the proton is discussed. The role of the weak interaction is considered, and a new particle with rest mass about 100 to 110 times the electron rest mass is predicted. (J.F.P.)

51784 ANALYSIS OF ρ POLARIZATION IN A $\pi^-p \to \pi\pi N$ EXPERIMENT AT 2.77 GeV/c. Bouchez, J.; Laurens, G.; Baton, J. P.; Cadiet, F. (CEN, Saclay, France). Nucl. Phys.; B45: No. 1, 205-16(1972).

Spin density matrix elements and the corresponding multipole parameters of ρ mesons produced in the reactions $\pi^-p \to \rho^0n$ and $\pi^-p \to \rho^-p$ obtained from a high statistics experiment at 2.77 GeV/c are computed, as functions of transfer, in the whole transfer domain. Representative points are plotted in multipole parameters space: it clearly shows the differences between the ρ^0 and ρ^- mesons, and allows, first an immediate test of the positivity conditions, and further a complete and easy confrontation to predictions of various models. (auth)

51785 INTEREST OF POLARIZATION IN MULTIPARTICLE PROCESSES. Drummond, I. T. (Univ. of Cambridge, Eng.); Kane, G. L. Nucl. Phys.; B45: No. 1, 157-80(1972).

Some interesting results which can be obtained for particle production amplitudes by measuring polarizations are considered. Although many of the remarks are general, only the Λ-polarization in processes $\pi(K)p \to K(\pi)\pi\Lambda$ is discussed in detail. Attention is given to what experimenters should measure, and how to interpret the direction of the Λ-polarization relative to the production plane. Possible interesting information that can be obtained includes detection of $K\pi$ resonances which do not show up in the cross section, determination of the normality of an exchanged particle between the nucleon–hyperon system and the meson system, and information on phases of production amplitudes such as phase variation due to Toller angle dependence. A complete formalism including a separation to leading order in s of exchanges of different normality is given in terms of both invariant amplitudes and helicity amplitudes. Numerical calculations are given for some simple models to indicate the kinds of results which might be found experimentally. (auth)

51786 K^+p DISPERSION RELATIONS. II. EPSILON EXCHANGE. Martin, B. R. (NORDITA, Copenhagen. University Coll., London). Nucl. Phys.; B45: No. 1, 102-8(1972).

The role of epsilon exchange in KN scattering is discussed in relation to a recent K^+p phase shift analysis based on partial-wave dispersion relations. The effective ϵ coupling constant is calculated and found to be positive, and to lie in the range $2 \lesssim f_{\epsilon K\bar{K}}f_{\epsilon N\bar{N}}/4\pi \lesssim 5$. (auth)

51787 DOES THE $\rho^0-\omega$ MIXING MAKE POSSIBLE AN ANOMALOUS VIOLATION OF THE ISOTOPIC SYMMETRY IN THE REACTIONS $\pi N \to \omega(N,\Delta)$. Achasov, N. N.; Shestakov, G. N. (Inst. of Mathematics, Novosibirsk, USSR). Nucl. Phys.; B45: No. 1, 93-101(1972).

The influence of electromagnetic ρ^0–ω-mixing on the reactions $\pi N \to \omega(N,\Delta)$ is analysed. It is pointed out that "strong" violation of the isotopic symmetry is possible in these reactions if one assumes that the ρ^0–ω interference in $\pi^\pm N \to \pi^+\pi^-(N,\Delta)$ occurs predominantly between the ρ^0 and ω production amplitudes with the π- and B-meson quantum numbers in the t-channel, respectively. (auth)

51788 INCLUSIVE REACTIONS, FINITE-ENERGY SUM RULES, AND REGGEON–PARTICLE SCATTERING. Ellis, S. D.; Sanda, A. I. (National Accelerator Lab., Batavia, Ill.). Phys. Lett.; 41B: No. 1, 87-92(4 Sep 1972).

Finite-energy sum rules are applied to inclusive reactions in the context of current data for $p + p \to p$ + anything and $p\pi \to p$ + anything. It is found that the finite-energy sum rules are indeed satisfied. Further results are interpreted in terms of Reggeon-particle scattering amplitudes. In particular, the questions of the validity of duality, the presence of fixed poles, and the possibilities of extracting specific triple-Regge couplings are discussed. Representative numerical values for these couplings are also given. (auth)

51789 TEST OF HADRONIC SCALING AT COSMIC-RAY ENERGIES. Fishbane, P. M.; Newmeyer, J. L.; Trefil, J. S.

(Univ., of Virginia, Charlottesville). Phys. Rev. Lett.; 29: No. 10 685-8(4 Sep 1972).

The use of data from cosmic-ray interactions with dense targets is discussed from the point of view of extracting information on scaling at high energies. A result is presented which relates single-particle distributions on nuclear targets to single-particle distributions on nucleons. Contrary to the conclusion first drawn from these data, no serious conflict between present data and a flat pionization region is found. (auth)

51790 OPTIMIZED FESR. Elvekjaer, Finn (Univ. of Aarhus, Denmark); Pietarinen, Esko. Nucl. Phys.; B45: No. 2, 621-36(1972).

An optimized FESR was developed especially for the determination of Regge pole residues. The optimum criterion is obtained by the requirement that the errors coming from the low energy integral as well as the errors originating from nonasymptotic intermediate energies and from unknown high energy terms should be made as small as possible. The method provides not only a more reliable determination of Regge pole residues but also it gives realistic error estimates. The method is applied to the determination of the ρ-pole residue in the invariant πN-amplitude $B^{(-)}$ for t = 0. (auth)

51791 POLARIZATION IN FORWARD $\pi^-p \rightarrow \pi^0n$ ($\pi^-p \rightarrow \eta n$) REACTION. Minami, Shigeo (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2142-3(Jun 1972).

The properties of polarization which can be derived from a Regge model for $\pi^-p \rightarrow \pi^0n$ ($\pi^-p \rightarrow \eta n$) interactions are discussed. The following points are emphasized: (i) the large polarization for the $\pi^-p \rightarrow \pi^0n$ reaction at $t \cong -0.5\ (\mathrm{GeV}/c)^2$ is associated with the dip of $d\sigma/dt$; (ii) the similar feature of P(t) cannot be expected in the $\pi^-p \rightarrow \eta n$ reaction in which there is no dip of $d\sigma/dt$; and (iii) pole-pole duality may be inconsistent with the data for P(t) in π^-p charge-exchange scattering. (L.B.S.)

51792 s-CHANNEL VERTICES FOR HIGHER-SPIN BOSON PRODUCTION. Gault, F. D.; Walter, P. J. (Univ. of Durham, Eng.). Lett. Nuovo Cim.; 4: No. 11, 461-5(15 Jul 1972).

A formalism for examining s-channel vertices for higher-spin boson production is presented. The formalism allows the use of any t-channel nonsense mechanism in the s-channel without explicitly requiring crossing. It is shown as a useful tool for examining both s-channel helicity conservation and t-channel helicity conservation as well as for parametrizing Regge couplings to higher-spin 0-s vertices. The formalism is illustrated for the processes $\pi p \rightarrow \epsilon p$ and $\pi p \rightarrow$ boson + p. (L.B.S.)

51793 PHENOMENOLOGICAL ANALYSIS OF POMERON-EXCHANGE AMPLITUDE FOR PION–NUCLEON SCATTERING AND CROSS SECTIONS DUE TO RESONANCES (NONRESONANT BACKGROUND). Inose, Masao; Karasuno, Toshiaki; Minami, Shigeo (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1910-21(Jun 1972).

Partial wave analysis of the Pomeron-exchange amplitude is performed under the assumption that there is no s-channel spin-flip part in Pomeron term. By making use of both the results and the phase shift solutions given by many authors, the resonant amplitude for pion-nucleon scattering is analyzed. The values of the parameters thus obtained enable the partial cross sections to be estimated for elastic (inelastic) scattering for the $J = l \pm 1/2$ state due to resonances or non-resonant background. On the basis of the results, the dual absorptive model is discussed. In order to confirm the existence of resonance, an attempt is made to describe the Argand diagrams for the scattering amplitudes in which the effects of Pomeron term are not included. (auth)

51794 DUAL REGGE CUT AMPLITUDES FOR πN SCATTERING. Yamagishi, Kenji (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1878-97(Jun 1972).

The dual resonance model with Regge cut is applied to πN scattering. It is shown that the factorization condition relates the relative magnitude of the ρ pole and its associated Regge cut contribution of the spin flip amplitude to the relative magnitude of the non-flip amplitude. The model can give a non-zero polarization of $\pi^-p \rightarrow \pi^0n$ at $\alpha_\rho(t) = 0$. (auth)

51795 WHAT DOES THE BOSON MISSING MASS SPECTRUM REVEAL? SPECULATIVE ARGUMENTS AND PHENOMENOLOGICAL ANALYSES ON HADRON LEVEL STRUCTURE. Namiki, Mikio; Ohba, Ichiro; Tamama, Teruo; Yap, Sue-pin (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1974-90 (Jun 1972).

Speculative arguments concerning internal hadron structure are given using the analogy of the boson missing mass spectrum in nuclear spectroscopy. Phenomenological analyses of the intermediate and gross structure of the spectrum are also performed to extract the direct data of the boson spectroscopy, and are compared with phenomenological theories based on the Veneziano model. (auth)

51796 πN CROSS SECTION THROUGH AN EXTRAPOLATION OF DEEP INELASTIC ELECTROPRODUCTION AND PHOTOPRODUCTION DATA. Langacker, P.; Suzuki, M. (Univ. of California, Berkeley). Phys. Lett.; 40B: No. 5, 561-5 (7 Aug 1972).

From PCAC and the equality between νW_2 for vector and axial vector currents in the Bjorken scaling limit, πN cross sections are calculated in good agreement with measurement through an extrapolation of νW_2 of electroproduction. They are further related to photoproduction cross sections. (auth)

51797 EVIDENCE FOR A G_{39}-RESONANCE IN πN SCATTERING. von Schlippe, W. (Univ., London). Lett. Nuovo Cim.; 4: No. 15, 767-70(12 Aug 1972).

A Legendre polynomial fit of $\pi^+ + p$ differential cross sections at 53 momenta from 0.8 to 2.8 GeV/c is presented. The established resonances F_{35}, P_{31}, F_{37}, and D_{35} are found in the peak near 1.5 GeV/c. Also there is an enhancement corresponding to a mass of 2160 MeV/c^2 for the resonance G_{39}. The quantum numbers of the G_{39} resonance are given. (J.F.P.)

51798 CONSISTENT RESONANCE DOMINACE OF FORM FACTORS USING SIDEWISE DISPERSION RELATIONS. Csikor, F. (International Centre for Theoretical Physics, Trieste). Lett. Nuovo Cim.; 4: No. 15, 754-6(12 Aug 1972).

It is shown that with a slight modification of the saturation pattern one may avoid the difficulty found previously that no consistent nontrivial solution exists for the saturation of sidewise dispersion relations for form factors by narrow resonances. But the method excludes the possibility of obtaining nontrivial information for on-mass-shell form factors. The example of the coupling of spin-$1/2$ baryons to a pseudoscalar meson is considered. The results also apply to the coupling of arbitrary-spin particles. (J.F.P.)

51799 RELATION BETWEEN THE AXIAL VECTOR AND MAGNETIC MOMENT FORM FACTORS OF NUCLEON. Riazuddin (Daresbury Nuclear Physics Lab., Eng.); Fayyazuddin. Phys. Lett.; 40B: No. 5, 583-5(7 Aug 1972).

A relation between the axial vector and magnetic moment form factors of nucleon is derived in the limit of infinite momentum transfer squared by using the concept of duality and a sum rule for deep inelastic lepton-nucleon scattering. The relation may be used to distinguish between quark and integrally charged triplet models. (auth)

51800 AMPLITUDE ANALYSIS OF THE REACTION $K^-p \rightarrow \pi^-Y^{*+}(1385)$. Aguilar-Benitez, M.; Chung, S. U.; Eisner, R. L.; Field, R. D. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett.; 29: No. 11, 749-53(11 Sep 1972).

A model-independent amplitude analysis of the reaction $K^-p \rightarrow \pi^-Y^{*+}(1385)$ at 3.9 and 4.6 GeV/c incident momenta is presented. By observing the two-step decay of the $Y^{*+}(1385)$ the magnitudes and two relative phases of the four independent transversity amplitudes which describe the reaction are determined. These amplitudes were found to be in rough agreement with the predictions of the naive quark model; however, the predictions do not hold exactly. (auth)

51801 THRESHOLD ENHANCEMENTS AND THE STATISTICAL BOOTSTRAP OF HADRONS. Johns, F. (McGill Univ., Montreal); Margolis, B.; Meggs, W. J.; Logan, R. K. Phys. Rev. Lett.; 29: No. 11, 756-9(11 Sep 1972).

A method of calculating inelastic hadronic processes is propose in which massive states are produced by Regge exchange and decay into final states with coupling strengths given by the statistica bootstrap of Frautschi. The invariant-mass distributions for a particular final state are peaked slightly above threshold and fall off exponentially with increasing mass. Good agreement with experiment is obtained for numerous reactions. (auth)

51802 PHENOMENOLOGICAL USE OF THE CALLAN–SYMANZIK EQUATION. Chan, W. K.; Wu, C. C. (Yale Univ., New Haven). Phys. Lett.; 40B: No. 6, 651-4(21 Aug 1972).

The Callan–Symanzik equation with the intrinsic breaking term omitted suggests an ansatz for the differential cross section in the high-energy, wide-angle limit. The agreement with experimental data for the reactions $ep \rightarrow ep$, $\pi^-p \rightarrow \pi^-p$, and $pp \rightarrow pp$ is very satisfactory. (auth)

51803 MODEL AMPLITUDE ANALYSIS OF $\pi^-p \rightarrow \pi^+\pi^-n$. Froggatt, C. D. (CERN, Geneva); Morgan, D. Phys. Lett.; 40B: No. 6, 655-61(21 Aug 1972).

An amplitude analysis of the process $\pi^-p \rightarrow \pi^+\pi^-n$ at 15 GeV/c is presented; spin and phase coherence of the production amplitude are assumed. The bearing of the results on aspects of dipion production phenomenology is discussed. (auth)

51804 POSSIBILITY OF STUDYING THE INTERACTION OF LONGITUDINALLY POLARIZED V^0 MESONS WITH NUCLEONS IN THE REACTION $\pi^-A \rightarrow V^0A'$. Gevorkyan, S. R.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 485-6(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 684-6(5 Jun 1972).

The interaction of longitudinally polarized vector mesons with nucleons is studied using the production of vector mesons in π^- reactions with nuclei. For this purpose a relation is found between the cross sections for the vector meson production in π^- reactions with nuclei and $\pi^- + p \rightarrow$ vector meson + n interactions. In this relation the effective number of nucleons depends on the total cross section of the transversely polarized vector mesons with the nucleons. (J.F.P.)

51805 FINITE ENERGY BOUNDS ON SCATTERING AMPLITUDES. Hahn, B. D.; Hodgkinson, D. P. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B46: No. 1, 232-52(1972).

The variational formalism of Einhorn and Blankenbecler is used to derive and evaluate numerically finite-energy bounds on the real and imaginary parts of an elastic scattering amplitude F(s,t). Previously, convergent bounds have been obtained by using the Jin–Martin theorem $\text{Im } F(s,t_0) < (s/s_0)^2$ where t_0 is the position of the nearest t-channel singularity. However, this introduces logarithmic factors of unknown scale, so to get bounds at finite energies $(s/s_0)^2$ is replaced by a phenomenological value of $\text{Im } F(s,t_0)$ found by extrapolation of the differential cross section. This procedure improves the bound of Singhand Roy at high energies and is also very successful at low energies. (auth)

51806 ANALYSIS OF THE $I_t = 0$ πN SCATTERING AMPLITUDES AT 6 GeV/c AND PROPERTIES OF THE POMERON TERM (HELICITY-NONFLIP OR SPIN-NONFLIP?). Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 4: No. 17, 995-8(26 Aug 1972).

An experiment was previously performed on the s-channel helicity nonflip and flip amplitudes ($F^{I_t}_{++}$ and $F^{I_t}_{+-}$) with isospin I_t in the t-channel. These results are further analyzed for F^0_{++} and F^0_{+-} studying how to separate the F^0 into the amplitudes $(F^0)_P$ and $(F^0)_{P'}$ due to the P and P′ trajectories and whether the property of the pomeron term is helicity-nonflip or spin-nonflip in the s-channel. It is shown that the pomeron term cannot be described well in terms of spin-nonflip amplitude but rather by the helicity-nonflip amplitude in the s-channel. (J.F.P.)

51807 STRONG SHRINKAGE OF $d\sigma/dt$ FOR πN SCATTERING AT $|t| = (1 \text{ to } 3)\ (\text{GeV}/c)^2$. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 4: No. 17, 999-1002(26 Aug 1972).

It is shown that the shrinkage of $d\sigma/dt$ for π + N interactions at $t = (1 \text{ to } 3)\ (\text{GeV}/c)^2$ can be understood in terms of the interference effect between the imaginary parts of the $I_t = 0$ helicity-nonflip amplitudes with energy dependence. (J.F.P.)

Strong (Baryon No. $\geq$ 2)

Refer also to abstract 52083.

51808 (BNL–16817) MONTE CARLO MODEL FOR MULTIPARTICLE PRODUCTION. Lyon, D. E. Jr. (Brookhaven National Lab., Upton, N. Y.). 24 Nov 1971. 17p. Dep. NTIS.

A Monte Carlo calculation based on the multiperipheral model of Chew and Pignotti is used to produce $d^2N/dpd\Omega$ distributions at energies up to a laboratory energy of 80,000 GeV. The momentum distribution employed is $d^3N \propto f(x,s)\ e^{-bp_T^2}\ d^3p/E$. The calculations produce scaling longitudinal momentum distributions that compare well with data that exist up to 1500 GeV laboratory energy. (auth)

51809 (COO–3130-TA-268) TESTS OF HADRONIC BREMSSTRAHLUNG PRODUCTION AT LARGE NUCLEON MOMENTUM TRANSFER. Fried, H. M. (Brown Univ., Providence, R. I. Dept. of Physics); Gaisser, T. K. (Bartol Research Foundation, Swarthmore, Pa.). 1972. 24p. Dep. NTIS.

It is suggested that hadronic bremsstrahlung may become the dominant production process in nucleon-nucleon reactions at large momentum transfer to the final nucleons. Correlation tests are proposed to distinguish the model from other models of inclusive processes. (auth)

51810 (COO–3130-TA-271) EIKONAL MECHANISMS AT HIGH ENERGY. Fried, H. M. (Brown Univ., Providence, R. I. Dept. of Physics). 1972. 17p. Dep. NTIS.

The discussion of eikonal mechanisms at high energies covers small-angle elastic and wide-angle inelastic p + p interactions. The nature of corrections to total cross sections for elastic scattering and a prediction of correlations expected in pion production proceeding by the bremsstrahlung of massive neutral vector mesons are treated. These eikonal descriptions are developed on an intuitive physical basis without mathematical rigor. (J.F.P.)

51811 (JINR–E2–5813, pp 73–154) INTERACTIONS OF HIGH AND SUPERHIGH ENERGY NUCLEI AND PARTICLES WITH NUCLEI. Barashenkov, V. S.; Iljinov, A. S.; Sobolevsky, N. M.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR).

From International school on high energy physics meeting; Varna, Bulgaria (13 Jun 1971).

High energy nuclear physics is of great "purely scientific" and applied importance. Statistical calculation methods based on intranuclear cascade model enable one to obtain agreement with known experimental data in the overall energy range above several dozens of MeV. At the energies $T \gtrsim 3-5$ GeV one must take into account the change of the nuclear density as the cascade of the particles showers inside the nucleus-target. Proceeding to the region of very high energies allowance also must be made for "multiparticle" interactions, when several fast particles simultaneously collide with one nucleon. The calculation methods, their results as well as difficulties encountered are briefly outlined. Particular attention is paid to the interactions of light nuclei d,t, ^{3}He and ^{4}He with the targets. (auth)

51812 (KFKI–72-36) SIMULTANEOUS EFFECT OF P-WAVE INTERACTIONS AND TENSOR FORCE ON THE POLARIZATION IN n–d SCATTERING. Doleschall, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 4p. Dep. NTIS (U. S. Sales Only).

A three-body calculation is performed at $E_n = 14.1$ MeV for the n-d elastic scattering which takes into account the $^1S_0$, $^3S_1-^3D_1$, and $^3P_2$ components of the nucleon–nucleon interaction. Good agreement with experimental data is obtained for the differential cross section and neutron polarization. The deuteron polarizations are also qualitatively reproduced. (auth)

51813 (LNF–72/65) MASSIVE LEPTON PAIR PRODUCTION AND THE SIZE OF THE PHOTON. Etim, E.; Greco, M.; Srivastava, Y. N. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 3 Jul 1972. 9p. Dep. NTIS (U. S. Sales Only).

An intuitive picture for understanding scaling in hadronic as well as nonhadronic processes is proposed which makes use of shrinkage of the size of the particle with its mass. An explicit model in agreement with experiment is also discussed. (auth)

51814 (SLAC-PUB–1033) LONG-RANGE CORRELATIONS AND THE DYNAMICS OF MULTIPARTICLE PRODUCTION. Friedman, Jerome H. (Stanford Linear Accelerator Center, Calif.); Risk, Clifford; Smith, Dennis B. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr 1972. 9p. (CONF-720206–4; LBL–935). Dep. NTIS.

From International conference on inclusive interactions; Davis, CA. (4 Feb 1972).

It was shown that the transverse-angle correlation between final-state leading particles is a sensitive indicator of the nature of secondary particle production in high energy collisions. Calculations from the multiperipheral model for associated pion production and from the pionization model for unassociated production in p + p interactions at high energies are compared. (J.F.P.)

51815 PHENOMENOLOGICAL STUDY OF INCLUSIVE SINGLE PARTICLE SPECTRA IN THE TRIPLE REGGE LIMIT. Ranft, J.; Ranft, Gisela (Karl-Marx Univ., Leipzig). Nucl. Phys.; B45: No. 1, 237-51(1972).

The M^* dependence of the slope $R(M^*)$ of $d\sigma/dtdM^*$ distributions in inclusive reactions $pp \rightarrow X$ + anything ($X = \pi^\pm, K^\pm, p$) is studied with the triple Regge graph. This graph predicts a slope variation similar to the statistical approach to the Veneziano model and to the thermodynamic model. It reproduces the trend of the experimental data at 19.2 GeV/c. Effective Regge parameters are determined by an energy dependent detailed least square fit which uses data of π^+, π^-, K^+, K^-, p and $\bar{p}$ spectra at 14.24, 19.2, 24 and 70 GeV/c. The good fit indicates that the triple Regge graph describes well the s, t and M^{*2} dependence of the data. The effective intercepts obtained in the fit are low compared to the trajectories known from two body data. (auth)

51816 INCLUSIVE HADRON SPECTRA AND THE MULTIPERIPHERAL MODEL. Ripa, P. (CNEA-Ciclotron, Buenos Aires). Nucl. Phys.; B45: No. 1, 217-36(1972).

A simplified version of the multiperipheral (MP) model developed by DeTar is improved so as to reproduce the experimental fragmentation spectrum. The model is then used to study the effect of introducing Pomeron exchange in the MP chain. Scaling behavior is shown to hold even at $x = 0$, where an inverted cusp of the form $A + B\sqrt{|x|}$ in the scaling function is found. This structure is in general related to non-leading trajectories and is shown to be present in Mueller's analysis and in other MP models without pomeron exchange. In the latter the amount of cusp is related to the coupling between different (input) channels. Non-scaling contributions, two-particle inclusive spectra and triple Regge limit are also discussed. (auth)

51817 EFFECTS OF Λ–Σ COUPLING IN ${}^4_\Lambda$H, ${}^4_\Lambda$He, AND ${}^5_\Lambda$He. Gibson, B. F.; Goldberg, A.; Weiss, M. S. (Univ. of California, Livermore). Phys. Rev., C; 6: No. 3, 741-8(Sep 1972).

The effect on the binding energies of ${}^4_\Lambda$He – ${}^4_\Lambda$H of inclusion of admixing the Σ particle is considered. The calculation is based on a Λ–N potential derived from ${}^5_\Lambda$He. This mixing explains the discrepancy in Coulomb energy of ${}^4_\Lambda$He – ${}^4_\Lambda$H, and leads to a consistent set of potential parameters. (auth)

51818 HIGH-ENERGY NEUTRON–NUCLEI TOTAL CROSS SECTIONS. Franco, Victor (Brooklyn Coll.). Phys. Rev., C; 6: No. 3, 748-57(Sep 1972).

Total cross sections for collisions between high-energy neutrons and nuclei are calculated by means of the Glauber approximation. Both Woods–Saxon and Gaussian density distributions are assumed for the nuclei. The two distributions yield results, which may differ from each other by as much as 15%. For light nuclei harmonic-oscillator wave functions are used. The calculations are compared with measurements for neutron energies above 1 GeV. A simple explanation is given to show why the dependence of the cross sections on the mass number A is greater than $A^{2/3}$. Although the multiple scattering series for a mass-A nucleus contains A terms, it is shown that excellent accuracy is obtained by retaining only approximately $3A^{1/3}$ terms, and a geometrical argument leading to this result is given. The ratios of the real to imaginary parts of the hadron–nuclei forward elastic scattering amplitudes are calculated, and the decrease of their magnitudes with increasing mass number is explained. The neutron–nuclei data are consistent with little or no regeneration. (auth)

51819 ANGULAR DISTRIBUTION PRODUCED BY THE t-CUT PHASE VOLUME. Yap, Sue-pin (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2133-5(Jun 1972).

The angular distribution in multiple production processes is investigated. Using the expression for the phase volume given by Byckling and Kajantie, the cosine distribution, the log $\theta^2/2$ plot, and the Duller–Walker plot are simulated for pp interactions with 6- and 8-body final state at 10, 100, and 500 GeV/c. It is suggested that the one straight line or two straight lines from the Duller–Walker plot can be understood by the t-cut mechanism. (L.B.S.)

51820 COMMENTS ON ARNOLD AND BARNETT'S SHIELDING-CUT MECHANISM. Fujisaki, Haruo (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2040-3(Jun 1972).

Brief comments are given at very high energies on phenomenological consequences of a shielding-cut mechanism recently proposed by Arnold and Barnett. (auth)

51821 INELASTIC PROTON–PROTON SCATTERING AND THE ELECTROMAGNETIC STRUCTURE OF THE PROTON. Nagatsuka, Yoshitaka; Sato, Masao (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1935-46(Jun 1972).

The differential cross sections for $p + p \rightarrow p +$ anything process are calculated by assuming similar behavior between the charge and hadronic matter distributions in the proton. The "inelasticity factor" was introduced to explain the highly inelastic process. The results are compared with the existing experimental data on $p + p \rightarrow p +$ anything process at 10, 12.4, 20, 30, 500, 1100 and 1500 GeV/c. Agreement with the data is remarkably good in spite of very few parameters. (auth)

51822 REGGE-LIKE BEHAVIOR OF NUCLEON–NUCLEON SCATTERING AMPLITUDES AT LOW ENERGY. Suemitsu, Hiroshi (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 1922-34(Jun 1972).

The possibility that the nucleon–nucleon scattering amplitudes have Regge-like behavior at low energy is investigated phenomenologically by assuming energy dependent coupling constants and exchanged meson masses, which give the damping and shrinkage effects on scattering amplitudes, respectively. These effects may be compared with those of Reggeized amplitudes. Analysis is made in terms of the partial wave dispersion relation utilizing the Kantor amplitude. The results show that both damping and shrinkage effects act to improve the fit to the experimental results. A discussion is made about a simple model having infinite one-particle-exchange structure whether or not such effects are appreciable at low energy. (auth)

51823 IS NEAR-FORWARD ELASTIC SCATTERING FROM NUCLEI IMPULSIVE OR ABSORPTIVE? Shibasaki, I.; Kohmura, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 4: No. 11, 457-60(15 Jul 1972).

The near-forward elastic scattering of hadrons from nuclei is investigated using the impulse approximation and the absorption model. It is shown that both of the models explain the near-forward scattering but they give different mass number dependences for the differential cross sections. It is concluded that the impulse approximation better reproduces the dependence obtained in the experiments. (L.B.S.)

51824 UNCORRELATED–JET MODEL FOR THE PIONIZATION PROCESS. Toda, A. (Tohoku Univ., Sendai, Japan). Lett. Nuovo Cim.; 4: No. 16, 874-8(19 Aug 1972).

The uncorrelated-jet model is applied to the process $N + N \rightarrow N + N + n\pi$ at very high energies. The function $\Omega_n(q)$ closely related to the pionization mechanism was found previously by A. Toda (Sci. Rep. Tohoku Univ., Ser I, 55 (1972) (to be published). An expression of Ω and Ω_π which makes it easier to find the characteristic features of σ_{inel} and σ_π is presented. It is assumed that there is no correlation among secondary pions in the final state except for energy-momentum conservation. (J.F.P.)

51825 THERMODYNAMICAL MODEL AND THE SINGLE-PARTICLE DISTRIBUTION. Kasahara, T. (Tohoku Univ., Sendai, Japan). Lett. Nuovo Cim.; 4: No. 16, 885-9(19 Aug 1972).

The thermodynamical model is used to study single-particle pion and proton distributions in $p + p \rightarrow p(\pi) +$ anything interactions. Longitudinal-momentum distributions characterized by a temperature T ($T \alpha \sqrt{s}$ approximately) are adopted. It is found that this model can give good fits to the ISR data. An intimate relation between the leading-proton spectra in inelastic $p + p$ scattering and deep inelastic $e + p$ scattering is found. (J.F.P.)

51826 CHEW–LOW APPROACH TO PION–NUCLEUS SCATTERING. Dover, C. B. (Brookhaven National Lab., Upton, N. Y.); Lemmer, R. H. Lett. Nuovo Cim.; 4: No. 11, 487-93 (15 Jul 1972).

A discussion of pion-nucleus scattering in the (3,3) resonance region is outlined based on a many-body approach developed recently for the study of pi-mesic atoms, in which the self-energy $\pi(q,\omega)$ of a pion moving with momentum q and energy ω in the nuclear medium is constructed. A generalization of the Chew–Low equations based on the method of functional derivatives is presented. An effective pion-nucleon forward scattering amplitude in the medium is defined by the first functional derivative of π with respect to the nucleon density. It is found that the pion-nucleus resonance is associated with a large decrease in the mean free path of the pion in the nucleus. (L.B.S.)

51827 PARASTATISTICS AND DEEP INELASTIC PROCESSES. Kingsley, R. L; Nash, C. (Univ. of Cambridge, Eng.). Lett. Nuovo Cim.; 4: No. 15, 802-4(12 Aug 1972).

It was previously shown that the assumption that quarks obey parastatistics of rank 3 has consequences for deep inelastic processes when analyzed in the parton model or using light cone current algebra. It is found that there is an observable, and less desirable, change in the predictions for heavy muon pair production in hadron–hadron collisions. (J.F.P.)

51828 ESTIMATE OF REGGE CUTS FROM INCLUSIVE FINITE MASS SUM RULES. Roy, D. P.; Roberts, R. G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 40B: No. 5, 555-60(7 Aug 1972).

Inclusive data on $K^+ \xrightarrow{p} K^0$ and $K^- \xrightarrow{p} \bar{K}^0$ are used to calculate the $\rho\rho$ and A_2A_2 Regge cuts in forward nucleon-nucleon scattering. Although the energies for which data exist are too low to allow a precise estimate, one can obtain an upper bound for the cut magnitude which is at the level given by the eikonal model. (auth)

51829 LEADING-PARTICLE AND MOMENTUM CONSERVATION EFFECTS IN THE DIFFRACTIVE MODEL FOR INCLUSIVE REACTIONS. Gordon, E. M. (McGill Univ., Montreal. Univ. of Cambridge, Eng.); Lam, C. S. Lett. Nuovo Cim.; 4: No. 15, 749-53(12 Aug 1972).

Inclusive $p + p \rightarrow p(\pi) +$ anything interactions are considered in the diffractive model. Correlations in the proton and pion spectra are explained as coming largely from momentum and energy conservation effects, and the flat spectrum at large y as coming mostly from those protons preferring a small t (leading-particle effect). (J.F.P.)

51830 STRUCTURE IN DIFFRACTION SCATTERING INSIDE $|t| \sim 4m_\pi^2$. Barshay, Saul; Chao, Yung-an (Univ. of Copenhagen). Phys. Rev. Lett.; 29: No. 11, 753-6(11 Sep 1972).

Through generalized t-channel unitarity relations it is argued that in a diffractive picture, it is unlikely for the high-energy elastic forward peak to be of a simple exponential form. The threshold behavior near the 2π branch point suggests that the diffraction slope will continuously increase with decreasing $|t|$ in the very forward direction. (auth)

51831 FIREBALL-LIKE STRUCTURE IN MULTIPERIPHERAL MODELS. Boldrighini, C. (Univ., Rome); Lusanna, L. Phys. Lett.; 40B: No. 5, 573-8(7 Aug 1972).

In the framework of multiperipherism the main features of the single particle inclusive processes $pp \rightarrow \pi(K)$ + anything at I.S.R. energies are studied. A two-bump structure is found in the x plot at fixed $q_\perp$, and a two-slope behavior for the $q_\perp^2$ plot is at fixed x. These features are consequences only of damping in momentum transfers. Connections with other results, such as angular distributions and K/π ratio at cosmic ray energies are discussed. (auth)

51832 ELEMENTARY PION WITH TRANSVERSE-MOMENTUM CUT-OFF FOR INCLUSIVE PROCESSES. Lusignoli, M. (Univ., Rome. Univ., Aquila, Italy); Srivastava, Y. Lett. Nuovo Cim.; 4: No. 12, 550-4(22 Jul 1972).

The idea of an elementary pion with transverse-momentum cutoff is applied to inclusive processes where π exchanges may play a dominant role (e.g., $p + p \rightarrow n$ + anything). It is found that the pion contribution to the neutron spectra in high-energy reactions of the type a + proton → neutron + anything can be absolutely related to $\pi-a$ total cross section and previously determined parameters. The two-particle spectra of the type $p + p \rightarrow n + n$ + anything is also derived and brief comments are made. (L.B.S.)

51833 MODIFICATION OF GLAUBER THEORY FOR DIFFRACTION DISSOCIATION OF HADRONS FROM NUCLEI. Van Hove, L. (CERN, Geneva). Nucl. Phys.; B46: No. 1, 75-88 (1972).

The formulation of the Glauber theory for diffraction dissociation of hadrons from heavy nuclei is modified to take into account the fact that the dissociated system D can oscillate between many internal states as it propagates through nuclear matter. The set of internal states of D is approximated by a continuum and the successive D-nucleon collisions are represented by a scattering amplitude which is taken to be a smooth function of the internal parameters of D. This smoothness property is argued to result from the very short time between successive D-nucleon collisions; it is therefore an off-shell effect. The physical implications of the modified scheme are an increased transparency of nuclear matter and a A-dependent modification in the distribution of internal D states, mainly a narrowing of the mass distribution. These effects are demonstrated by the numerical treatment of a highly simplified example. (auth)

51834 TOTAL CROSS SECTIONS OF NUCLEI–NUCLEI COLLISIONS. Tekou, Amouzou (Univ. of Benin, Lome, Togo). Nucl. Phys.; B46: No. 1, 152-63(1972). (In French).

A method of the approximate calculation of the total cross sections of the nucleon-nucleon scattering is worked out in the framework of Glauber's multiple scattering theory. The total cross sections of the collisions of the lightest nuclei (p, d, He^3 and He^4) with some medium and heavy nuclei are calculated. (auth)

51835 CONCERNING THEORIES OF DEUTERON COLLISIONS WITH NUCLEI AT HIGH ENERGIES. Tekou, Amouzou (Univ. of Benin, Lome, Togo). Nucl. Phys.; B46: No. 1, 141-51(1972). (In French).

The connection between the model of opaque nucleus and that of Glauber for the case of the deuteron-nucleus scattering is studied. It is shown that the contribution, to the total cross section, of the nucleus virtual excitations induced by the double scattering processes in which all the nucleons of the deuteron take part, is negligible when the nucleus becomes absolutely opaque. (auth)

51836 THEORETICAL MODEL-INDEPENDENT DETERMINATION OF THE REAL PARTS AND ZEROS OF THE pp, $\bar{p}$p FORWARD SPIN-INDEPENDENT SCATTERING AMPLITUDES. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B46: No. 1, 164-72(1972).

A new method of analyzing experimental data on pp and $\bar{p}$p scattering is used to obtain an accurate determination of the real parts of the forward scattering amplitudes. The locations of zeros of the amplitudes are calculated by means of the analytical continuation of the scattering amplitude parametrized in the physical region to complex values of energy. The method exploits the known analyticity properties of the scattering amplitude and experimental data in a limited energy range. However, unlike conventional dispersion relation calculations, it requires no assumptions about the amplitudes in the unphysical and asymptotic regions. (auth)

51837 GENERALIZED GLAUBER FORMULA WITH RECOIL. Namyslowski, J. M. (Univ., Warsaw). Lett. Nuovo Cim.; 4: No. 12, 517-20(22 Jul 1972).

A generalized Glauber formula is derived for πd elastic scattering, taking into account recoil terms in an eikonal approximation. (L.B.S.)

51838 COHERENT DROPLET MODEL INCLUDING A YUKAWA INTERACTION TERM FOR HIGH-ENERGY pp SCATTERING. Rotsstein, A. N. (Clarkson Coll. of Tech., Potsdam, N. Y.). Nuovo Cim., A; 10: No. 4, 747-52(21 Aug 1972).

A modification of the coherent droplet model for elastic proton-proton scattering is proposed in which the imaginary part of the phase shift arises from the usual contact interaction but with real part resulting from a Yukawa interaction between the hadronic-matter distributions. For the Yukawa term two distinct cases are considered—the exchange of a single vector meson and the exchange of two different vector mesons. The latter case is found to yield good agreement with the high energy data for mass values of 810 and 2240 MeV. (auth)

51839 SEPARABLE POTENTIALS AND COULOMB INTERACTIONS. Ali, S.; Rahman, M. (Atomic Energy Centre, Dacca, Bangladesh). Phys. Rev., D; 6: No. 4, 1178-80(15 Aug 1972).

In the coordinate representation it is possible to get a neat and exact expression for scattering phase shifts assuming the scattering potential to be nonlocal but separable. It is shown that such a formulation is still useful even when the Coulomb potential is included in the nonlocal Schroedinger equation. As an illustration, the effective-range parameters for p–p scattering were obtained. (auth)

51840 HELICITY STRUCTURE OF LOW-ENERGY NUCLEON–NUCLEON SCATTERING AMPLITUDE. Kawasaki, M. (Hiroshima Univ.); Yonezawa, M.; Watari, W. Lett. Nuovo Cim.; 4: No. 17, 935-9(26 Aug 1972).

A phenomenological analysis is made for the helicity structure of the imaginary parts of the nucleon–nucleon scattering amplitudes in the elastic region. The results show that there are certain similarities in the imaginary parts of the amplitudes at low energies with those at high energies and suggest that the nucleon–nucleon system has a common underlying structure through the energy range. A simplification of the structure in helicity amplitudes is found. (J.F.P.)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 51867, 51878, 51880, 51881, and 52296.

51841 (LYCEN–7233) ON THE SUITABLE VALUE OF THE INVARIANT OPERATOR OF THE GROUPS SU(n) AND SO(2q+1). Partensky, Alain (Lyon Univ. (France). Institut de Physique Nucleaire). Jul 1972. 95p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A very simple derivation is given for the eigenvalue of the invariant operators of the groups SU(n) and SO(2q + 1). (J.F.P.)

51842 WEAKLY BROKEN SUBSYMMETRIES OF CHIRAL $SU_3 \times SU_3$ AND THE LIMIT OF NO EXPLICIT BREAKING. Bessler, L.; Welling, D. (Univ. of Wisconsin, Milwaukee). Lett. Nuovo Cim.; 4: No. 11, 466-8(15 Jul 1972).

It is pointed out that the agreement between recent analyses of the $(3,3^*) + (3,3^*)$ model of broken chiral $SU(3) \times SU(3)$ symmetry and the limit $\epsilon_0 \rightarrow 0$ and $\epsilon_8 \rightarrow 0$ and the results of Gell–Mann, Oakes, and Renner is not surprising. To make this plausible, the equations of the Glashow–Weinberg model are solved, using the approximation that, even when the symmetry is explicitly broken, the transformations of the asymptotic $0^\pm$ fields should be the same, at least up to terms linear in the fields, as they are when the Hamiltonian is invariant. (L.B.S.)

51843 EVALUATION OF THE MULTIPLICITY-FREE WIGNER COEFFICIENTS OF U(n). Chacon, E.; Ciftan, Mikael; Biedenharn, L. C. (Duke Univ., Durham, N. C.). J. Math. Phys. (N. Y.); 13: No. 5, 577-90(May 1972).

An explicit algebraic expression [containing the minimal number (n − 1) sums] for the general reduced Wigner coefficients associated with the multiplicity free Kronecker product $[h_1 \cdots h_n] \times [p0 \cdots 0]$ of irreducible representations of U(n), is determined. The calculation employs a combined use of recursive relations derived for the Wigner coefficients, and matrix elements (with respect to Gel'fand basis states) of a generator of U(n) raised to an arbitrary power. Also an alternative procedure using the techniques of the "pattern calculus" is given. The method is illustrated first for the case of U(3) and then generalized to arbitrary U(n). It is found that the results can be expressed succinctly in terms of a new algebraic function S_{nm}—thereby elucidating the structural details of the underlying algebra. (auth)

51844 LORENTZ GROUP AND HARMONIC ANALYSIS. Ruehl, W. Mathematical Physics Monograph Series. New York; W. A. Benjamin, Inc. (1970). 308p.

The topics covered are representation theory, unitary representations of the inhomogeneous SL(2,C) group, representations of the group SL(2,C), harmonic analysis of polynomially bounded functions on the group SL(2,C), and representations of the group SL(2,R). Also covered are harmonic analysis of polynomial bounded functions on the group SL(2,R), harmonic analysis of representations of the group SL(2,C) on the subgroup SU(1,1), and Regge and Toller poles. (J.F.P.)

51845 WAVE ZONE OF RADIATION. Bagrov, V. G.; Bordovitsyn, V. A.; Kopytov, G. F. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 30-3(1972). (In Russian).

The concept of the wave zone is fundamental to the theory of a radiating charge. The criterion for the formation of a wave zone of radiation associated with a moving charge is examined. The phenomenon of the wave zone was investigated for synchrotron radiation and the radiation of a hyperbolically moving charge. Special attention was given to the ultrarelativistic case. (tr-auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 51579, 51600, 52037, and 52051.

51846 WEAK AND ELECTROMAGNETIC INTERACTION SYMMETRY. Tanaka, K.; Torgerson, R. (Ohio State Univ., Columbus). Nucl. Phys.; B45: No. 2, 637-44(1972).

An analogy between a triplet of quarks and a triplet of leptons is discussed in the framework of a model of weak and electromagnetic interactions possessing local $SU(2)_L \times U(1)$ symmetry. After the symmetry is broken spontaneously by use of the Higgs–Kibble mechanism, two of the quark masses are non-zero. The relation of the quark masses to the chiral SU(3) × SU(3) model of strong interactions as well as the Cabibbo angle is discussed. (auth)

51847 INTERPRETATION OF NIU'S EVENT IN THE THEORY OF THE O(4) SYMMETRY. Sato, Shigeo (Rikkyo Univ., Tokyo); Nakamura, Seitaro. Progr. Theor. Phys. (Kyoto); 47: No. 6, 1991-7(Jun 1972).

An interpretation for a new cosmic ray event reported by Niu et al. is given on the basis of the O(4) symmetry. It is considered that Niu's particle, called X particle, is a boson belonging to a $\partial_{1/2,3/2}$ multiplet (isospin $I = 1/2$, and strangeness $S = 3$), and that the event is a sort of the nonleptonic decay $X^+ \rightarrow \pi^+\pi^0$. (In the O(4) symmetry formulated by the present authors, the transition with $|\Delta S| > 1$ cannot in general be excluded from the category of the normal weak decay.) It is shown that all possible modes of the strong decay can be forbidden for the X particle or at least can be suppressed by the selection rules. The life time for the decay $X^+ \rightarrow \pi^+\pi^0$ is estimated by comparing to that for the decay $K_S^0 \rightarrow \pi\pi$, and is found to be in good agreement with the observation. (auth)

51848 MODEL FOR LEPTON, NUCLEON, AND PION INTERACTIONS. Palmer, William F. (Ohio State Univ., Columbus). Phys. Rev., D; 6: No. 4, 1190-3(15 Aug 1972).

An $SU(2)_L \times Y_L$ gauge theory is studied. The purely leptonic part is the Weinberg theory. The purely hadronic part is a form of the SU(2) × SU(2) σ model. It is shown, following the suggestion of Weinberg, that with a cross-coupling term the spontaneous breaking of the lepton symmetry induces a spontaneous breaking of the SU(2) × SU(2) hadron symmetry, resulting in a partially-conserved-axial-vector-current condition for axial-vector divergences and pions which are Goldstone–Nambu particles in an appropriate limit. (auth)

51849 MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Lee, Benjamin W. (National Accelerator Lab., Batavia, Ill.). Phys. Rev., D; 6: No. 4, 1188-90(15 Aug 1972).

A model of weak and electromagnetic interactions of leptons and hadrons is presented based on the spontaneously broken gauge symmetry O(3) × O(2). The advantages of the model are the following: (1) The universality of the β and μ decays emerges naturally; (2) there appears only positively charged heavy leptons, and no neutral heavy leptons which might affect the muon (g−2) factor adversely; (3) a neutral current shows up only as a short-range weak parity violation in electromagnetism, and nowhere else. (auth)

51850 K_L-K_S MASS DIFFERENCE IN A CHIRAL APPROACH. Riazuddin (Daresbury Nuclear Physics Lab., Eng.); Fayyazuddin. Lett. Nuovo Cim.; 4: No. 17, 981-4(26 Aug 1972).

The chiral approach is used to estimate the two-pion contribution to the $K_2^0-K_1^0$ mass difference. It is found that this contribution appears to be important in explaining the experimental value and sign of the studied mass difference. (J.F.P.)

51851 MICROSCOPIC IRREVERSIBILITY IN THE NEUTRAL-KAON SYSTEM AND THE ONSAGER RELATIONS. Aharony, A. (Tel-Aviv Univ., Israel). Lett. Nuovo Cim.; 4: No. 17, 988-90(26 Aug 1972).

The validity of the Onsager relations among irreversible processes is investigated for K^0 decay. In order to discuss these relations a previous general formalism for the master equation for the reduced density matrix of the $K^0-\bar{K}^0$ complex interacting with a thermal bath of pions and other possible decay products is extended to the case where the final-state bosons may form several heat baths with unequal temperatures. It is found that the $K^0-\bar{K}^0$ system gives a possibility of checking the necessity of time-reversal symmetry for the existence of Onsager's relations. (J.F.P.)

51852 VIOLATION OF CP, T AND CPT INVARIANCE AND NONLOCALITY. Kim, D. Y. (Univ. of Saskatchewan, Regina). Lett. Nuovo Cim.; 4: No. 17, 1014-18(26 Aug 1972).

It is shown that violations of CP, T, and CPT invariance can be attributed to nonlocal effects in $K^0 \rightarrow 2\pi$ decay. It was found that the violation of CP and CPT invariance may be caused by mass difference, whereas the violation of T invariance does not depend on mass difference. (J.F.P.)

Applications (Strong)

51853 (ORO-3992-104) NEW ESTIMATE OF THE PARAMETER "c" OF GELL-MANN, OAKES AND RENNER IN THE $(3,3^*) \oplus (3^*,3)$ MODEL OF SU(3) × SU(3) SYMMETRY-BREAKING. Sebastian, K. J. (Texas Univ., Austin. Center for Particle Theory). Aug 1972. Contract AT(40-1)-3992. 11p. (CPT-158). Dep. NTIS.

A new estimate of the parameter "c" of Gell-Mann, Oakes and Renner is made through the Fubini-Furlan-Rosetti technique of covariant dispersion theory of equal-time commutation relations. It is found that $c \approx -0.2$ supporting the "weak PCAC," hypothesis of Brandt and Preparata. (auth)

51854 W-PARITY, OCTET DOMINANCE, AND THE BREAKING OF CHIRAL SYMMETRY. McDonald, A.; Rosen, S. P. Kuo, T. K. (Purdue Univ., Lafayette, Ind.). Phys. Lett.; 41B: No. 1, 78-82(4 Sep 1972).

It is shown that W-invariance together with octet dominance restricts the SU(3) × SU(3) symmetry breaking Lagrangian to the representations $(3,\bar{3}) \oplus (\bar{3},3)$, $(6,\bar{6}) \oplus (\bar{6},6)$, (8,8), and $(1,8) \oplus (8,1)$. In a nonlinear model, this Lagrangian predicts that the T = 2, S-wave π–π scattering length is zero; and when fitted to the empirical pion and K-meson masses, it predicts a T = 0 scattering length of 0.26 m^{-1}. Compared with the $(3,\bar{3}) \oplus (\bar{3},3)$ model, this model gives a larger (by a factor 8/3) nucleon σ-term, in agreement with recent calculations. (auth)

51855 WEAKLY BROKEN SUBSYMMETRIES OF HADRONS. Bessler, LeRoy; Welling, Daniel J. (Univ. of Wisconsin, Milwaukee). Phys. Rev., D; 6: No. 4, 1092-1100(15 Aug 1972).

The relation between explicit and spontaneous breaking of chiral SU(3) × SU(3) symmetry is analyzed. Because it is assumed that the transformations of the asymptotic fields, even if nonlinear, are the same up to the linear term as they are in the limit of no explicit symmetry breaking, it is possible to solve the equations of the Glashow–Weinberg model. Using only the pseudoscalar-meson masses and the ratio of the kaon and pion leptonic decay constants as input, the remaining parameters of the model are computable. Numerical results are obtained for M_K^2, $Z_K^{1/2}/Z_\pi^{1/2}$, $\epsilon_0/\sqrt{2}\epsilon_0$, and $\langle 0|u_8|0\rangle/\sqrt{2}\,\langle 0|u_0|0\rangle$. Figures display the dependence of M_K^2 on the ratio F_K/F_π. Two noteworthy features of the analysis are: (1) The Glashow–Weinberg model admits two types of solutions simultaneously, one characterized by chiral SU(2) × SU(2) as a weakly broken subsymmetry [i.e., by the hadron Hamiltonian's being approximately invariant under chiral SU(2) × SU(2)], which is the view of Gell-Mann, Oakes, and Renner, and the other by SU(3) as a weakly broken subsymmetry, which is the view of Brandt and Preparata. (2) The limit of no explicit symmetry breaking is realized with the entire spinless chiral multiplet degenerate in mass, and massless if either the full symmetry or any subsymmetry is spontaneously broken. It is made plausible that recent studies of the limit of no explicit symmetry breaking which find an octet of pseudoscalar Goldstone bosons and an SU(3)-invariant vacuum do so because their assumptions or approximations guarantee that they must. (auth)

51856 MODEL OF SPONTANEOUS BREAKDOWN OF SU(3) x SU(3) SYMMETRY. II. Bhargava, Ashok Kumar (Indian Inst. of Tech., Kanpur). Phys. Rev., D; 6: No. 4, 1153-69(15 Aug 1972).

The effective-Lagrangian model studied in an earlier paper by Bhargava and Dass is employed with slight modification to study the three-particle decay modes of axial-vector and pseudoscalar mesons, the elastic scattering of two pseudoscalar mesons (π-π, K-π, and K-K scattering), the K_{14} form factors, and the K_{14} decay widths. It is found that in most cases, for example π-π, K-π, and K-K scatterings and K_{14} decay, the scalar-meson contributions are significant. A limit of the model in which masses of chiral partners of the Goldstone bosons became infinite is discussed and predictions in this limit are compared with those of current algebra and nonlinear effective Lagrangians. It is found, in this limit, that if the Kawarabayashi–Suzuki–Riazuddin–Fayyazuddin relation is assumed the S-wave I = 0, 2 π-π scattering lengths become zero. (auth)

51857 MASS-DISPERSION RELATIONS AND BROKEN SCALE INVARIANCE. O'Donnell, P. J.; Wong, T. P. (Univ. of Toronto). Phys. Rev., D; 6: No. 4, 1026-33(15 Aug 1972).

The hypothesis is investigated that there is a simple connection between the operators which break dilatation invariance and those which violate chiral symmetry. Using the $(3,\bar{3}) \oplus (\bar{3},3)$ model for breaking chiral SU(3) $\otimes$ SU(3) symmetry and the mass-dispersion relations of Fubini and Furlan a sum rule is obtained for the π-N scattering-length combination $a_1 + 2a_3$ and the dimension of the chiral symmetry-breaking terms. For d = 3 the current-algebra calculation is reproduced, without assuming the absence of the σ term. (auth)

Field Theories

General

51858 SOME PROPERTIES OF AN AESTHETIC FIELD THEORY. Muraskin, M. (Univ. of North Dakota, Grand Forks). Found. Phys.; 2: No. 2-3, 181-8(Apr 1972).

The study of the Lorentz-invariant field theory based on the equations $\Gamma^i_{jk;l} = 0$ and $g_{ij;k} = 0$ is continued. To first order in a perturbation expansion, it is found that $\Gamma^i_{jk;l} = 0$ reduces to the wave equation. In orders higher than the first, it is found that $\Gamma^i_{jk;l} = 0$ cannot be linearized. It is found that the simple wave-type equation $g^{ij}\,\partial^2 g/\partial x^i \partial x^j = 0$ is contained in the theory when an appropriate choice is made for the parameters at the origin point. (auth)

51859 GAUGE INDEPENDENT GRAVITATIONALLY-COUPLED ELECTROMAGNETIC FIELD. Aragone, C. Commun. Math. Phys.; 26: No. 3, 205-21(1972).

A totally 3-covariant formulation is given of the gravitationally coupled electromagnetic field (with a source) in terms of physical 3-covariant variables, keeping the correspondence with the A.D.M. formulation of the problem. A 3-covariant time derivation which allows one to discuss the spreading of the transverse and longitudinal components of the electromagnetic field is introduced. Then the second-order propagation equation and the Hamiltonian 3-covariant equations are presented in a complete electromagnetic gauge independent fashion using the well-known elliptic operator $\Delta(g_{ij})$, and also the dynamical impossibility of disentangling the transverse and longitudinal modes is discussed. Thereafter the 3-covariant formulation is extended to the gravitational field, and the problems of the initial conditions for the full system are considered. Finally, the formalism is applied to the merostatic sourceless problem, showing the connection between the merostatic and the static cases. (auth)

Quantum Field Theory

Refer also to abstracts 51730, 51921, 51928, 52288, and 52293.

51860 (ITF-72-4-P) STABLE TRAJECTORIES OF THE DYNAMICS AND EQUATION OF QUANTUM THEORY. Piragas, K. A.; Aleksandrov, A. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The principle of stability of motion of a mechanical system is used to drive, under certain assumptions, a Schroedinger equation in an arbitrary coordinate system. A similar method for relativistic theory leads to the Klein–Gordon equation. (auth)

51861 (LNF-72/35) SELF CONSISTENCY CONDITION IN CONFORMAL COVARIANT FIELD THEORY. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 24 Apr 1972. 5p. Dep. NTIS (U. S. Sales Only).

It was previously shown that in a conformal invariant field theory with trilinear interaction it was possible to write a self-consistency equation for the vertex and the conformal invariant solution of this equation is determined by the knowledge of the renormalized coupling constant and the anomalous dimension. It was also shown that the solution of the system $F(\eta,g) = 1$ and $H_v(\eta,g) = 1$ gives the anomalous dimension of the field and the renormalized coupling constant for the zero-mass theory. A very simple relation between the functions F and H is found in order to avoid unnecessary computations. (J.F.P.)

51862 (LNF-72/46) ANOMALOUS DIMENSIONS IN ONE DIMENSIONAL QUANTUM FIELD THEORY. Parisi, G.; Zirilli, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 29 May 1972. 10p. Dep. NTIS (U. S. Sales Only).

The short distances behavior of the Green's functions of two operators in a soluble one-dimensional model of quantum field theory with adimensional coupling constant are studied. Noninteger power behavior comes out, and the leading terms of the Wilson's expansion of two operators at short distances are determined. (auth)

51863 (LNF-72/47) NON EQUIVALENCE BETWEEN CONFORMAL CONVARIANT WILSON EXPANSION IN EUCLIDEAN AND MINKOWSKI SPACE. Ferrara, S.; Grillo, A. F.; Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 30 May 1972. 7p. Dep. NTIS (U. S. Sales Only).

In connection with work on operator products in quantum field theories, it is pointed out that a conformal covariant Wilson expansion cannot be done in Euclidean space in the usual sense. The correct conformal covariant prescription is found which has to be used in order to obtain the operator product expansion in the pseudo-Euclidean space–time. (J.F.P.)

51864 (LNF-72/51) CRITICAL INDICES FOR THE SPHERICAL MODEL FROM CONFORMAL COVARIANT SELF CONSISTENCY CONDITIONS. Parisi, G.; Peliti, L. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Jun 1972. 4p. Dep. NTIS (U. S. Sales Only).

Critical indices for the spherical model are computed in arbitrary dimension space. Well known exact results are recovered in three-dimensional space. The key tools used are conformal covariant self-consistency conditions. (auth)

51865 PARTICLE VELOCITIES FASTER THAN THE SPEED OF LIGHT. Gruber, Gary R. (Hofstra Univ., Hempstead, N. Y.). Found. Phys.; 2: No. 1, 79-82(Jan 1972).

In connection with another work it is shown how it might be possible to travel faster than the speed of light. It is shown that for clocks and rods moving faster than the speed of light one obtains instead of time dilation and Lorentz contraction respectively, time contraction and Lorentz expansion respectively. It is shown that the results confirm earlier work. (auth)

51866 CONSERVATION OF KINKS AND SPIN IN NONLINEAR QUANTUM FIELD THEORIES. Williams, J. G. (Univ. of Birmingham, Eng.). J. Math. Phys. (N. Y.); 13: No. 8, 1165-8 (Aug 1972).

Certain nonlinear field theories exhibit particlelike structures called "kinks" that have fermionlike properties. A Feynman path integral approach is used to show that, in the quantum theory, the number of kinks and the spin associated with them are both conserved quantities. (auth)

51867 ULTRALOCAL QUANTUM FIELD THEORY IN TERMS OF CURRENTS. I. THE FREE THEORY. Newman, Charles M. (Princeton Univ., N. J.). Commun. Math. Phys.; 26: No. 3, 169-204(1972).

The possibility of constructing ultralocal theories, whose Hamiltonians contain no gradient terms and are therefore diagonal in position space, entirely in terms of currents with an equal time current algebra replacing the canonical commutation relations is considered. It is shown that the free current theory can be defined in terms of a certain representation of the current algebra related to the group, SL(2,R). This representation is then constructed by using certain results of Araki and in the process a new infinitely divisible state on the universal covering group of SL(2,R) is displayed. An ultralocal free theory can also be constructed for the canonical fields, and its relation to the free current theory is shown to involve a certain renormalization procedure reminiscent of the thermodynamic limit. (auth)

51868 ASYMPTOTIC SCALE INVARIANCE IN A MASSIVE THIRRING MODEL. Gomes, M.; Lowenstein, J. H. (Univ. of Pittsburgh). Contract AT(30-1)-3829. Nucl. Phys.; B45: No. 1, 252-66(1972).

The absence of Callan–Symanzik coupling-constant renormalization in a massive Thirring model is demonstrated to all orders using normal product methods. The derivation depends crucially on the mildness of the "anomaly" of the axial-vector Ward identity in this model, as well as on the special relationship between vector and axial-vector currents in two-dimensional field theory. Application of power-counting arguments establishes the asymptotic scale invariance of the vertex functions when the mass m tends to zero with the normalization point μ either fixed (Gell–Mann–Low limit) or vanishing with m (Callan–Symanzik limit). (auth)

51869 REMARKS ON THE INFINITE-COMPONENT SOLUTIONS TO THE BETHE–SALPETER EQUATION. Seto, Kenji (Gakushuin Univ., Tokyo); Nakanishi, Noboru. Progr. Theor. Phys. (Kyoto); 47: No. 6, 2148-50(Jun 1972).

A brief review is given of the infinite-component solutions to the Bethe–Salpeter equations in the equal-mass Wick–Cutkosky model. Comments are then made on the results. (L.B.S.)

51870 COVARIANT T* PRODUCTS AND SCHWINGER TERMS. Watanabe, Tadashi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2077-84(Jun 1972).

Field theoretical investigation of current algebra is made by employing model Lagrangians of the chiral pion dynamics and the massive Yang–Mills field. In addition to the algebraic structure of currents the seagull and Schwinger terms are given in explicit forms. Feynman's conjecture is also discussed in connection with the cancellation of the divergences between the seagull and Schwinger terms. (auth)

51871 FEYNMAN RULES FOR EFFECTIVE LAGRANGIANS. Finkelstein, Robert J.; Kvitky, Joel S. (Univ. of California, Los Angeles). Progr. Theor. Phys. (Kyoto); 47: No. 6, 2055-76 (Jun 1972).

The Lee–Yang analysis of charged vector theories is applied to massive gauge fields and related effective Lagrangians. It has been found that the Lee–Yang matrix for the massive gauge field is unimodular. The unimodular condition is here applied to effective Lagrangians defined by chiral vector fields and leads to the Weinberg condition $m_A = \sqrt{2}\, m_v$. When applied to an effective Lagrangian describing electromagnetically coupled gauge fields, the same condition leads to the usual renormalization of the electromagnetic field, the electric charge and the ρ and ϕ masses. Simple Feynman rules may be inferred for all the Lagrangians discussed. (auth)

51872 NEW TEST OF THE SECOND POSTULATE OF SPECIAL RELATIVITY SENSITIVE TO FIRXT-ORDER EFFECTS. Cialdea, R. (Univ., Rome). Lett. Nuovo Cim.; 4: No. 16, 821-5 (19 Aug 1972).

A new method sensitive to first-order effects in the ratio $u/c = \beta$ between the velocity u of the laboratory with reference to a hypothetical absolute frame and the light velocity in empty space is described. An experiment is reported based on this method by which a new upper limit is obtained for the absolute velocity u. This limit is one hundred times smaller than the lowest value obtained thus far. The new method gives the magnitude and sign of the velocity u. (J.F.P.)

51873 GAUGE PROPERTIES OF THE RARITA-SCHWINGER FIELD WITH SPIN $^3/_2$. Soo, W. F.; Kamefuchi, S. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 4: No. 16, 853-6(19 Aug 1972).

The gauge properties of the Rarita–Schwinger field are discussed in the Stueckelberg formalism for spin $^3/_2$. This formalism is generalized in certain respects. It is found that the studied field, when coupled to a given J_μ, does not give rise to any unrenormalizable effects. (J.F.P.)

51874 AXIOMS OF QUANTUM THEORY OF LOCALIZABLE FIELDS AND THEIR CONSEQUENCES. Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 555-70(1972). (In Russian).

A review of the axiomatic approach in quantum theory of interacting fields is given. N. N. Bogolubov's and A. S. Wightman's axiomatics are compared. Some consequences are considered which can be checked in experiment (asymptotic theorems). (auth)

51875 STRONG GRAVITY AND THE YUKAWA POTENTIAL. Peak, D. (State Univ. of New York, Albany). Lett. Nuovo Cim.; 4: No. 16, 817-20(19 Aug 1972).

It is shown in what sense the Yukawa potential represents a correspondence limit for the strong-gravity interaction. Hadron motion in a curved space–time is considered. The rest mass of a particle in a stationary and static field is found. (J.F.P.)

51876 SELF-CONSISTENCY CONDITIONS IN CONFORMAL COVARIANT FIELD THEORY. Parisi, G. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 4: No. 15, 777-80(12 Aug 1972).

It was previously shown that the solution of the system $F(\eta,g) = 1$ and $H_\nu(\eta,g) = 1$ yields the anomalous dimension of the field and the renormalized coupling constant for the zero-mass theory. From these a self consistency equation for the vertex and its solution can be found. A very simple relation is found between the functions F and H in order to avoid unnecessary computations. (J.F.P.)

51877 COVARIANT POLARIZATION MATRIX FOR TENSOR AND RARITA–SCHWINGER FIELDS. Gabos, Z. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 1, 29-39(1972). (In German).

Proceeding from the knowledge of the wave functions of the free tensor and Rarita–Schwinger fields, a constructive procedure for calculating the covariant polarization matrix was developed. The applicability of the method was demonstrated by exhibiting the concrete form of the covariant polarization matrix for particles with spin values $^3/_2$ and 2 in two different representations. (tr-auth)

51878 RELATIVISTIC INVARIANCE IN QUANTUM THEORY. Shirokov, Yu. M. (Inst. of Mathematics, Moscow). Fiz. Elem. Chastits At. Yadra; 3: No. 3, 606-49(1972). (In Russian).

The purpose of the work is twofold. The first one is to present the unifield and most general viewpoint on the problem of the formulation of the relativistic invariance conditions. The second one is to review the consequences following from the invariance conditions which were so far either not included at all or treated incompletely in the existing textbooks and monographs. The first part of the whole work which is presented below contains the general formulation of the problem of the relativistic invariance in terms of the group automorphisms of the algebraic systems and also the theory of the irreducible representations of the Poincarè group. The complete system of the unitary as well as nonunitary irreducible representations of the group is obtained including the representations corresponding to the one-dimensional little groups which were discovered recently. (auth)

51879 LOWEST ORDER "DIVERGENT" GRAPHS IN ν-DIMENSIONAL SPACE. Bollini, C. G.; Giambiagi, J. J. (Univ. Nacional, La Plata). Phys. Lett.; 40B: No. 5, 566-8(7 Aug 1972).

The lowest order "divergent" graphs, for a scalar $\Psi^2\Phi$-coupling theory, are computed as functions of the number of dimensions ν of the space. The result is seen to be finite for odd-dimensional spaces. For even-dimensional spaces it is shown that ν can be used as an analytic regularization parameter. (auth)

51880 LIE ALGEBRAS AND QUANTUM MECHANICS. Hermann, Robert. Mathematics Lecture Note Series. New York; W. A. Benjamin, Inc. (1970). 335p.

The Lie algebra approach to classical and quantum mechanics, quantization of constrained systems, current algebras and gauge groups, representations of the algebra of currents, and algebraic construction of Schwinger terms, a differential geometric formalism for multiple integral variational problems with applications to quantum field theory, are treated. Also covered are quantization of classical field theories using differential forms, propagators and scattering, a geometric viewpoint in quantum field theory, and scattering theory in generalized function spaces and on manifolds. (J.F.P.)

51881 NECESSARY AND SUFFICIENT CONDITIONS FOR CONSERVATION OF CURRENTS GENERATING INTERNAL AND CONFORMAL SYMMETRIES. Gal-Ezer, E. (Tel-Aviv Univ., Israel). Nuovo Cim., A; 10: No. 4, 682-8(21 Aug 1972).

Assuming that the energy-momentum spectrum is contained in the closed forward light-cone, necessary and sufficient conditions for conservation of translationally covariant and of conformal currents are proven. These theorems can be interpreted as generalizations of Coleman's theorem. (auth)

51882 FIELDS WITHOUT PARTNERS. Hegerfeldt, Gerhard C. (Univ., Goettingen, Ger.); Klauder, John R. Nuovo Cim., A; 10: No. 4, 723-38(21 Aug 1972).

It is proved that field operators characteristic of ultra-local quantum-field theories do not possess conjugate partner fields fulfilling canonical commutation relations in the Weyl form. The analysis, which is based on a study of the expectation functionals, eliminates any possible partners whatsoever, not only the ones suggested by dynamical considerations. (auth)

51883 SOME REMARKS ON NONPOLYNOMIAL FIELD THEORIES WITH ZERO MASS. Montaldi, E. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Lett. Nuovo Cim.; 4: No. 12, 521-6(22 Jul 1972).

The essential features of a simple technique are described, which proves to be useful in the framework of nonpolynomial field theories with zero mass. The technique is illustrated for the case of the logarithmically divergent integral corresponding to the fermion second-order self-energy graph for a model of scalar isospin-$\frac{1}{2}$ nucleons integrating by scalar neutral mesons. In particular, the role of the minor coupling constant as an effective inbuilt cut-off is exhibited. (L.B.S.)

51884 INVARIANT FUNCTIONAL FORMULATION OF CHIRAL DYNAMICS. Batalin, I. A.; Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). Nucl. Phys.; B46: No. 1, 173-89 (1972).

Invariant functional formulation of $SU(2) \otimes SU(2)$ chiral dynamics is considered. A system of invariant functional equations for the (S-matrix) generating functional is obtained as well as the infinite system of integral equations for the Green functions. It is shown, that all the Green functions of chiral currents may be expressed in terms of the Green function of the quantized Sugawara equation and its vertex part. The solution of the functional equations of the theory is obtained in a closed form as a functional integral over the chiral current divergence. To remove the divergences, regularization is introduced by means of finite number of invariant counterterms, added to the original Lagrangian. The approximate calculation of the generating functional by the stationary phase method applied to the functional integral over the chiral current divergence is studied. (auth)

51885 LIGHT-CONE SINGULARITIES IN CLASSICAL AND QUANTUM FIELD THEORIES WITH INTERACTION. Dietz, K.; Meetz, K. (Univ., Bonn.). Nucl. Phys.; B46: No. 1, 89-99 (1972).

It is shown that the light-cone singularity suggested by the SLAC experiment on deep inelastic electroproduction is already given by the singularity of the classical current-current Poisson bracket. The form of the latter turns out to be exactly the one proposed by Fritsch and Gell-Mann, only the fields constituting local and biolocal currents are modified by the interaction. Translating this result into quantum field theory it is pointed out that anomalous singularities occurring in the field commutator cancel in the current commutator. (auth)

51886 CLOSED-LOOP REGULARIZATION AND ANOMALOUS WARD IDENTITIES. Breitenlohner, P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Mitter, H. Nuovo Cim., A; 10: No. 4, 655-66(21 Aug 1972).

Closed fermion loops with an arbitrary number of vertices are investigated by means of gauge-invariant analytic regularization. The vertices may correspond to arbitrary operators bilinear in the spinor field. A simple algorithm for the computation of these loop diagrams is presented, and some useful properties are displayed. Rules for the calculation of Ward identity anomalies are given which can be executed by computer programs for Feynman diagrams. Some triangular diagrams are considered as illustrative examples. (auth)

51887 CONFORMAL COVARIANT OPERATOR-PRODUCT EXPANSIONS. Bonora, L.; Sartori, G.; Tonin, M. (Univ., Padua). Nuovo Cim., A; 10: No. 4, 667-81(21 Aug 1972).

A result obtained by Ferrara, Gatto and Grillo is generalized by giving a conformal covariant representation for the operator-product expansion of any two tensor local operators. The cases of spin-0 and spin-1 fields are discussed in detail. (auth)

51888 .GUPTA-BLEULER FORMALISM WITH SCALAR FERMIONS IN MASSLESS YANG-MILLS THEORY. Rudolph E.; Duerr, H. P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., A; 10: No. 4, 597-612(21 Aug 1972).

In the Yang-Mills theory a formalism corresponding to the conventional Gupta-Bleuler formalism in quantum electrodynamics leads to difficulties with regard to the probability interpretation. It is shown that the tree diagrams of the S-matrix are gauge invariant and that nevertheless the S-matrix leads out of the physical subspace $\hat{H}$ with positive semi-definite metric. The S-matrix projected onto the physical subspace hence is no longer unitary. In order to arrive at a unitary theory the original Gupta-Bleuler formalism has to be extended by introducing a complex scalar isovector field which obeys anticommutation rules. As a consequence, the usual connection between spin and statistics does not hold in the large state space. This does not pose any difficulty because an indefinite metric is used in the state space. The scalar fermions contribute in such a peculiar way as to cancel all bad effects of the Gupta-Bleuler ghosts in the original formulation, yielding, therefore, the correct Feynman diagrams with the usual analyticity properties. It is possible to give a consistent probability interpretation for the asymptotic particles within this formalism without any additional unitarization procedure. In comparison with quantum electrodynamics the ghost structure is much more complicated and the indefinite metric nontrivial. Nevertheless, the notation of good and bad ghosts with some modification remains the most suitable language also in this extended Gupta-Bleuler formalism. (auth)

51889 CAUCHY PROBLEM AND THE RELATIVISTIC BOLTZMANN EQUATION. Bancel, Daniel (Univ., Paris). J. Math. Pures Appl.; 51: No. 2, 257-71(1972). (In French).

The Cauchy problem was studied for the linearized and nonlinearized Boltzmann equations in the framework of special relativity, a simple hypothesis on the integrability of the collision cross sections being assumed. (France)

51890 FOURTH-ORDER CHARGE RENORMALIZATION IN SPIN-ZERO ELECTRODYNAMICS. Hagen, C. R. (Univ. of Rochester, N. Y.); Kim, Ick-joh. Phys. Rev., D; 6: No. 4, 1185-8(15 Aug 1972).

The discrepancy between two recent calculations of the divergent part of Z_3 in scalar electrodynamics is resolved. It is shown that in both approaches certain improper operations have been performed on linearly divergent diagrams. The terms which are necessary to correct each of these two calculations are determined and the results thereby brought into agreement. It is found that while the corrections happen to cancel in Sinclair's approach, there is a nonvanishing contribution to the earlier result of the present authors. (auth)

51891 MULTIPERIPHERALISM, SOFT PARTONS, AND THE DEGENERACY OF THE VACUUM. Schonberg, Edmond; Susskind, Leonard (Yeshiva Univ., New York). Phys. Rev., D; 6: No. 4, 1148-53(15 Aug 1972).

In an attempt to explain the Feynman distribution of "wee" partons, a ϕ^3 theory is examined in the infinite-momentum frame under various approximations. It is found that the multiperipheral graphs of such a theory produce power laws for the parton distribution, and it is also shown that those graphs give a very unreliable picture of the ground state of the system. A semiclassical approximation is found to be more reliable, and shows conclusively that a ϕ^3 theory cannot lead to a Feynman distribution. In a classical one-dimensional field theory, the conditions for the appearance of solutions that mimic the Feynman distribution are then examined. It is shown that in this case the existence of such solutions is connected with the presence of a degenerate ground state. (auth)

51892 FOURTH-ORDER CONTRIBUTION TO Z_3^{-1} IN SCALAR ELECTRODYNAMICS. Sinclair, D. K. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 6: No. 4, 1181-4(15 Aug 1972).

Two previous calculations of Z_3^{-1} to fourth order in scalar electrodynamics were in disagreement. It is shown that, with slight modifications to one of these calculations, they are brought into agreement. A simpler calculation, in which the Ward identities are explicit, is presented. (auth)

51893 EXTENSION OF JOST AND SCHROER'S THEOREM TO QUANTUM ELECTRODYNAMICS. Strocchi, F. (Princeton Univ., N. J.). Phys. Rev., D; 6: No. 4, 1193-5(15 Aug 1972).

An extension of Jost and Schroer's theorem to quantum electrodynamics is presented. (auth)

51894 TWO-POMERANCHUKON CUT AND ITS RELATION TO DIFFRACTIVE INCLUSIVE PROCESSES. Muzinich, I. J.; Paige, Frank E.; Trueman, T. L.; Wang, Ling-lie (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 6: No. 4, 1048-59 (15 Aug 1972).

Within the framework of the Gribov Reggeon calculus the discontinuity of the two-Pomeranchukon cut is related to the Pomeranchukon-particle and amplitude measured in diffractive inclusive processes. Assuming that the triple-Pomeranchukon vertex vanishes for zero-mass legs, it is shown how this relationship continues to be valid when the Pomeranchukon-particle amplitude contains the exchange of Pomeranchukon poles or cuts. In particular, it is shown that the Gribov–Migdal bound is not valid in general. An estimate of the magnitude of the two-Pomeranchukon cut is given. (auth)

51895 SOME GENERAL CONSEQUENCES OF REGGE THEORY FOR POMERANCHUKON-POLE COUPLINGS. Jones, C. Edward; Low, F. E.; Tye, S.-H. H.; Veneziano, G.; Young, J. E. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 6: No. 4, 1033-8(15 Aug 1972).

Without reference to specific Regge models, and assuming only the validity of asymptotic Regge-pole expansions, unitarity and exact sum rules are used to draw conclusions concerning the couplings of the vacuum pole $\alpha_p(0)$. If $\alpha_p(0) < 1$ an upper bound on the triple-vacuum coupling is derived. Assuming $\alpha_p(0) = 1$ it is proved that either the (t = 0) Pomeranchukon-particle-Reggeon coupling vanishes for all Reggeon masses, or the (t = 0) Pomeranchukon–Reggeon–Reggeon coupling vanishes. The vanishing of either the Pomeranchukon–Pomeranchukon–Reggeon vertex at zero mass, or the Mueller-like Pomeranchukon–Reggeon-particle-particle vertex, again all Reggeons at zero mass, is also proved. The model-independent technique is used to recover the Finkelstein–Kajantie result that the Pomeranchukon–Pomeranchukon-particle coupling vanishes for $\alpha_p(0) = 1$; if $\alpha_p(0) < 1$ an inequality is obtained for the coupling. The influence of Regge cuts is neglected. (auth)

51896 THIRRING MODEL IN TERMS OF CURRENTS: SOLUTION AND LIGHT-CONE EXPANSIONS. Dell'Antonio, G. F. (Univ., Naples); Frishman, Yitzhak; Zwanziger, Daniel. Phys. Rev., D; 6: No. 4, 988-1007(15 Aug 1972).

Exact expansions of operator products, in terms of c-number functions singular on the light cone and regular operators, are exhibited explicitly in the Thirring model. For the products $\psi_1(x)\psi_1^\dagger(x')$ and $\psi_2(x)\psi_2^\dagger(x')$ of fermion fields the expansion reduces to one term only, with the c-number function having a singularity on the light cone which depends on the coupling constant, and the regular operator depending only on the currents, which are free. The resulting formula allows one to calculate all Wightman functions in terms of current matrix elements and thereby provides a simple and complete solution to the Thirring model. The different charge sectors are realized as inequivalent irreducible representation spaces of the canonical current commutation relations, on which the charged field ψ acts as an intertwining operator. (auth)

51897 MINIMAL ELECTROMAGNETIC COUPLING OF SPIN-TWO FIELDS. Hagen, C. R. (Univ. of Rochester, N. Y.). Phys. Rev., D; 6: No. 4, 984-7(15 Aug 1972).

The apparent increase in the number of degrees of freedom of a massive spin-two field upon introduction of minimal electromagnetic coupling is considered. It is shown that if one gives up the usual formulation of such a system in favor of one possessing fewer dependent field components such a problem does not occur. It is consequently suggested that minimal coupling may be a useful concept only within the framework of theories which are described with a minimal number of components. (auth)

51898 WARD IDENTITIES FOR LOCAL GAUGE SYMMETRIES. Quaranta, L. (Univ., Marseilles); Rouet, A.; Stora, R.; Tirapegui. Lett. Nuovo Cim.; 4: No. 17, 924-6(26 Aug 1972).

A proof is given of Ward identities independently of the existence of a gauge-invariant regularization procedure. This is illustrated using the example of the Higgs–Kibble model where all ghosts are massive. The Slavnov identities are also derived. (J.F.P.)

Gravitation and General Relativity

51899 (AD–739367) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF GRAVITATION. Annual Summary Report, January–December 1969. Dicke, R. H. (Princeton Univ., N. J. Dept. of Physics). Feb 1970. Contract N00014-67-A-0151-0018. 13p. NTIS.

Owing to the universal character of gravitation it is involved in all parts of physics. Furthermore, because of the great weakness of gravitation on an atomic scale, the experimental investigation of relativistic gravitation requires large bodies. During the past year, the sun, the crab nebula pulsar, the galaxies and clusters of galaxies were among the gravitationally bound objects studied. (NTIS)

51900 (ITF–72-43-P) ON THE GENERAL RELATIVITY SHIFT EFFECT OF GRAVITATIONAL VIBRATION FREQUENCY IN THE EARTH FIELD OF SCHWARZSCHILD. Shirokov, M. F.; Ivashenko, A. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new effect, due to Shirokov, of the difference in frequencies of the gravitational vibrations of frequencies in the earth satellite in a plane perpendicular to the orbit and in an orbital plane is considered. A theory of this effect is given. (auth)

51901 (ITF–72-61-P) PROBLEM OF BODY MOTION IN THE GENERAL RELATIVITY THEORY. Ryabushko, A. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The problem of n-body motion in the postNewton approximation of general relativity is considered when the latter carry the charges and "inborn" magnetic moments. The integrals of motion are obtained. The problem of experimental verification of the effects in this case is discussed. (auth)

51902 (JINR–P2-6564) STATIC SCALAR FIELD AND "EVENT HORIZON". Asanov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

In the general relativity the weak static scalar field can exclude the creation of the event horizon. The simplest generalization of the massless scalar field equation is used. An example of the electrically and scalar charged static body is given. The radius of the body $[R \sim 0.9\ (\kappa\ m/c^2)]$ is a little less than dimensions of the event horizon ordinary considered. No singularity occurs. (auth)

51903 LOCAL AND COVARIANT QUANTIZATION OF LINEARIZED EINSTEIN'S EQUATIONS. Bracci, L. (Scuola Normale Superiore, Pisa, Italy. Univ., Pisa, Italy); Strocchi, F. J. Math. Phys. (N. Y.); 13: No. 8, 1151-63(Aug 1972).

An analysis is given of all the possible quantizations of the linearized Einstein equations in terms of a weakly local and/or covariant potential $h_{\mu\nu}(x)$. The discussion is done without making the apparently arbitrary choices which characterize the standard formulations, and special attention is paid in proving those general features which follow from basic principles and are therefore common to all local and/or covariant formulations. It is shown that the requirement of locality and/or covariance alone implies that the Einstein equations cannot hold as mean values on a dense set of states, and therefore unphysical states must be introduced in an essential way. Moreover, the requirement that the Einstein equations hold as mean values on the physical states forces the existence of states of negative norm in order to define $h_{\mu\nu}$ as a local and/or covariant operator. Thus the characteristic features of Gupta's formulation are shown to be shared by any local and/or covariant theory. The arbitrary choices which occur in the representation of the field operator $h_{\mu\nu}$, in the definition of the metric operator and in the choice of the subsidiary condition which identifies the physical states, are shown to lead to only a one-parameter family of theories. They can be classified according to the subsidiary condition $(\partial\mu h_{\mu\nu} + q\,\partial_\nu h_{\mu}\mu) + \Psi = 0$, each $q \neq -\frac{1}{4}$ identifying a possible theory. This arbitrariness, which makes the literature on the subject rather confusing, is resolved by proving that all the theories are (isometrically) equivalent. Such formulations are discussed in the framework of axiomatic quantum field theory, with particular emphasis on their group theoretical contents. Finally, an extensive treatment of Gupta's formulation is given along the lines discussed by Wightman and Gärding for quantum electrodynamics. (auth)

51904 SOLUTIONS OF A CLASS OF NONLINEAR COUPLED PARTIAL DIFFERENTIAL EQUATIONS. Swenson, Robert J. (Montana State Univ., Bozeman). J. Math. Phys. (N. Y.); 13: No. 8, 1112-14(Aug 1972).

A class of nonlinear coupled partial differential equations are solved. These are generalizations of the general relativistic equations arising for a static distribution of massive charged particles. (auth)

51905 MEASURABILITY ANALYSIS OF THE ELECTRIC-TYPE COMPONENTS OF THE LINEARIZED GRAVITATIONAL RADIATION FIELD. Smith, Gerrit J. (Syracuse Univ., N. Y.). Found. Phys.; 2: No. 2-3, 189-222(Apr 1972).

The equivalence principle as well as the spin-two character of the weak gravitational field lead to difficulties in the measurability analysis of this field which are not encountered in Bohr and Rosenfeld's corresponding inquiry into the electromagnetic field. To meet these difficulties, atomic elastic structures are proposed as gravitational field detectors whose parameters (masses, total volumes, lattice and elastic constants) are adjustable. The limitations imposed by the uncertainty principle and by the radiation reaction of the detectors on the determination of the amplitude, frequency, and direction of the field are then exhibited. Finally, the relevance to the investigation of DeWitt and to Einstein's full theory of gravitation is briefly considered. (auth)

51906 NEW APPROACH TO THE THEORY OF RELATIVITY. III. PROBLEM OF THE ETHER. Janossy, L. (Central Research Inst. of Physics, Budapest). Found. Phys.; 2: No. 1, 9-25(Jan 1972).

The considerations of the former work concerning the special and general theories of relativity are extended. The question of the physical reality of the ether and the interpretation of some cosmological problems are discussed. A view is expanded according to which the metric tensor g is taken as the energy momentum tensor of the ether. The gravitational equation of Einstein is considered to represent the equations of motion of the ether. The cosmological red shift is also interpreted in such terms. (auth)

51907 GENERALIZED LIENARD–WIECHERT FIELDS. Couch, W. E.; Newman, E. T. (Univ. of Pittsburgh). J. Math. Phys. (N. Y.); 13: No. 7, 929-31(Jul 1972).

It is shown that a moving point multipole source for a spin-S field gives rise to radiation having (in the rest frame of the source) multipole structure of order S through 2L + S, where L is the highest order moment of the source. (auth)

51908 DEGENERATE GRAVITATIONAL FIELDS WITH TWISTING RAYS. II. Zund, J. D. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 4: No. 16, 879-80(19 Aug 1972).

Two special classes of degenerate static-vacuum static gravitational fields admitting a twisting-ray congruence are exhibited. (J.F.P.)

51909 POLARIZATION OF GRAVITATIONAL SYNCHROTRON RADIATION. Breuer, R. A. (Univ. of Maryland, College Park); Tiomno, J.; Vishveshwara, C. V. Lett. Nuovo Cim.; 4: No. 16, 857-60(19 Aug 1972).

A method of analysis of the polarization of gravitational synchrotron radiation in terms of Stokes parameters similar to those used for the electromagnetic case is proposed. Also analytic expressions of these parameters for the studied radiation corresponding to the Schwarzschild black hole model are given. It is noted that these may be of interest for an estimate of the mass loss rate of the galaxy on the grounds of Weber measurements of gravitational wave polarization properties. (J.F.P.)

51910 SET OF GENERALIZED HEISENBERG RELATIONS AND A POSSIBLE NEW FORM OF QUANTIZATION. Rauscher, E. A. (Univ. of California, Berkeley). Lett. Nuovo Cim.; 4: No. 15, 757-60(12 Aug 1972).

A generalized set of canonically conjugate variables obeying commutation relations is presented in terms of universal constants, which are the generalized Heisenberg relations. These variables, termed quantal units or quantized variables geometrize the space–time manifold and can be expressed in the generalized metric form given previously. (J.F.P.)

51911 SOLUTIONS OF THE EINSTEIN–MAXWELL EQUATIONS WITH MANY BLACK HOLES. Hartle, J. B.; Hawking, S. W. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Commun. Math. Phys.; 26: No. 2, 87-101(1972).

In Newtonian gravitational theory a system of point charged particles can be arranged in static equilibrium under their mutual gravitational and electrostatic forces provided that for each particle the charge, e, is related to the mass, m, by $e = G^{1/2}m$. Corresponding static solutions of the coupled source free Einstein–Maxwell equations have been given by Majumdar and Papapetrou. It is shown that these solutions can be analytically extended and interpreted as a system of charged black holes in equilibrium under their gravitational and electrical forces. Also some of stationary solutions of the Einstein–Maxwell equations discovered by Israel and Wilson are analyzed. If space is asymptotically Euclidean it is found that all of these solutions have naked singularities. (auth)

51912 PROPERTIES OF THE f–g THEORY. Aragone, C.; Chela-Flores, J. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim., A, 10: No. 4, 818-23(21 Aug 1972).

Making use of the small-excitation technique, the content of the physical massive tensor field which enters in the 2-tensor theory formulated by Isham, Salam and Strathdee is studied. It is shown that the physical massive field contains, in general, a pure spin-2 field and one spin-0 field. By employing the ADM techniques, the sign of the energy for the free massive field is also analyzed. Finally, the asymptotic behavior is given for the spherically symmetric static free massive field. Also the behavior of this solution in the vicinity of the source is discussed. (auth)

51913 MOMENTUM CONSTRAINTS AS INTEGRABILITY CONDITIONS FOR THE HAMILTONIAN CONSTRAINT IN GENERAL RELATIVITY. Moncrief, Vincent (Univ. of Maryland, College Park); Teitelboim, Claudio. Phys. Rev., D; 6: No. 4, 966-9(15 Aug 1972).

It is shown that if the Hamiltonian constraint of general relativity is imposed as a restriction on the Hamilton principal functional in the classical theory, or on the state functional in the quantum theory, then the momentum constraints are automatically satisfied. This result holds both for closed and open spaces and it means that the full content of the theory is summarized by a single functional equation of the Tomonaga–Schwinger type. (auth)

51914 BEST-FIT ESTIMATE OF RELATIVISTIC EFFECTS IN TIME-DELAY EXPERIMENTS. Richard, Jean-Paul (Univ. of Maryland, College Park). Phys. Rev., D; 6: No. 4, 961-6(15 Aug 1972).

Time-delay experiments are analyzed within the frame of a curved space-time. Residuals from Newtonian best fits of relativistic data are used as a measure of the "relativistic effects." Radial transponder trajectories are considered. If the motion is towards the sun, the relativistic residuals are of the order of 100 m. If the motion is away from the sun, they are at the 10-km level and the fraction due to the second-order curvature of the metric is at the 1-km level. Those effects are significantly smaller than those calculated from the divergence of the Newtonian and relativistic predictions after exact fit of the initial measurements. (auth)

51915 RELATIVITY GYROSCOPE EXPERIMENT AT ARBITRARY ORBIT INCLINATIONS. Barker, B. M.; O'Connell (Louisiana State Univ., Baton Rouge). Phys. Rev., D; 6: No. 4, 956-61(15 Aug 1972).

A calculation of the "indirect" quadrupole moment effect (given by "averaging" the de Sitter term, $\vec{\Omega}_{DS}$, over a period of the motion) is carried out for "distorted" elliptical orbits of small eccentricity at arbitrary inclination to the earth's equator. Combining this with other effects enables the total gyro precession to be calculated. The question of what is the optimum orbit for the relativity gyroscope experiment is then discussed. (auth)

51916 FRIEDMANIAN PERFECT-FLUID COSMOLOGIES FOR DESER SCALER–TENSOR THEORY. Aragone, C.; Restuccia, A. (Istituto de Fisica, Montevideo, Uruguay). Lett. Nuovo Cim.; 4: No. 17, 962-4(26 Aug 1972).

The Friedman solutions having a perfect fluid as their source are shown for the new Deser scalar–tensor cosmological theory. (J.F.P.)

51917 CONSTRUCTION AND OPERATION OF A WEBER-TYPE GRAVITATIONAL-WAVE DETECTOR AND OF A DIVIDED-BAR PROTOTYPE. Bramanti, D.; Maischberger, K. (ESRIN, Frascati, Italy). Lett. Nuovo Cim.; 4: No. 17, 1007-13 (26 Aug 1972).

Some relevant characteristics of a Weber-type detector and the observation of its thermal noise are described. Also for comparison the operation of a divided-bar prototype is briefly discussed. (J.F.P.)

51918 VERY-HIGH-FREQUENCY GRAVITATIONAL RADIATION FROM NEUTRON STARS. Boccaletti, D. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Lett. Nuovo Cim.; 4: No. 17, 927-31(26 Aug 1972).

The Weinberg formula, which gives the emission rate and spectrum of soft gravitons in an arbitrary collision process, is applied to the scattering between neutrons in a neutron star. The result, which can exceed the intensity estimated for the sun by a factor of nearly 10^{12}, implies that gravitons produced in this way have a very high frequency and that the intensity can be much higher in the early instants of a neutron star. The total power emitted as gravitational radiation from a neutron star including all the frequencies of the spectrum and without any cut-off is found to be about 10^{27} ergs/s. From a neutron star with an inner temperature of about 10^{9} °K there will be an emission of 10^{23} Hz gravitons at a rate of 10^{23} gravitons/s. The existence in the universe of a background of high-energy gravitons due to all neutron stars which have been formed up to now is expected. (J.F.P.)

Scattering Theory

Refer also to abstracts 51624, 51644, 52069, and 52295.

51919 HYPERGEOMETRIC STRUCTURE OF THE GENERALIZED VENEZIANO AMPLITUDES. Mano, Koichi (Air Force Cambridge Research Labs., Bedford, Mass.). J. Math. Phys. (N. Y.); 13: No. 8, 1136-9(Aug 1972).

A multiple integral representation for a function of $n(n-1)/2$ variables, which reduces to the $(n+3)$-point generalized Veneziano amplitude for unit values of the variables, is integrated out once to obtain a recurrence formula for the amplitude. The result of complete integration obtained through repeated use of the recurrence formula is shown to belong to a class of generalized hypergeometric functions of many variables which are similar to but are more complex than the Lauricella functions. It is shown also that the $(n+3)$-point amplitude for $n \geq 3$ can be represented as a linear combination of an infinite number of ${}_{n+1}F_n[1]$ series with varying parameters. (auth)

51920 GENERALIZATION AND APPLICATIONS OF THE SASAKAWA THEORY. Kowalski, K. L. (Case Western Reserve Univ., Cleveland). Nucl. Phys.; A190: No. 3, 645-54(1972).

The Sasakawa theory of scattering is phrased in the form of a Fredholm reduction technique for integral equations possessing a fixed-point singularity in their kernels. This permits the generalization of this theory to a large variety of scattering integral equations. Some specific applications include the two-particle off-shell and multichannel scattering problems. In the first instance a rank-three approximation to the fully off-shell transition matrix is derived which is exact on and half-off shell, satisfies off-shell unitarity, and possesses no unphysical singularities. In the second problem it is shown how the method leads to the generation of a unitary approximation to the multichannel amplitudes. (auth)

51921 RELATIVISTIC EIKONAL PROPAGATORS AND HIGH-ENERGY SCATTERING IN QED. Dittrich, W. (Univ., Tuebingen, Ger.). Nucl. Phys.; B45: No. 1, 290-302(1972).

Functional methods are presented for constructing the relativistic eikonal propagator in an external electromagnetic field whereby large virtual momenta of the exchanged vector meson are taken into account. The high-energy scattering amplitude is presented in the Levy—Sucher representation. Results include the usual cancellation of ln s terms and unitarity correction if non-ladder-type diagrams (towers) are included. Contact is made with earlier work on eikonal amplitudes in the forward direction. (auth)

51922 SCATTERING THEORY: THE QUANTUM THEORY ON NONRELATIVISTIC COLLISIONS. Taylor, John R. New York; John Wiley and Sons, Inc. (1972). 490p. $14.95.

The topics discussed include the scattering operator for a single particle, cross sections in terms of the S-matrix, scattering of two spinless particles and of two particles with spin, invariance principles and conservation laws, particles with spin, the Green operator and the T operator, the Born series, stationary scattering states, the partial-wave stationary states, and analytic properties of the partial-wave amplitude. Also covered are resonances, single-channel scattering, dispersion relations and complex angular momenta, the scattering operator in multichannel scattering, cross sections and invariance principles in multichannel scattering, fundamentals of time-independent multichannel scattering, properties of the multichannel stationary wave functions, analytic properties and multichannel resonances, and identical particles. (J.F.P.)

51923 SPHEROIDAL BOUND STATES ROTATIONALLY INVARIANT: ZERO-ENERGY CASE. Ronveaux, A. (Notre Dames de la Paix, Belgium). Lett. Nuovo Cim.; 4: No. 16, 839-44(19 Aug 1972).

Using the phase approach conditions simpler than previous ones are given for spheroidal potentials, which are the most important nonspherical potentials. Only states which are rotationally invariant (such that the wave function does not depend on the rotation angle) and η-independent are considered. These states contain the ground state. (J.F.P.)

51924 EIKONAL APPROXIMATION FOR FORWARD AND BACKWARD SCATTERING. Noble, J. V. (Univ. of Virginia, Charlottesville). Phys. Lett.; 40B: No. 5, 525-8(7 Aug 1972).

Elastic scattering in the presence of direct plus space-exchange potentials leads to differential cross sections which are both forward- and backward-peaked. By expanding about the forward and backward directions simultaneously, one can derive exactly soluble coupled integral equations for the forward- and backward-scattering amplitudes. (auth)

51925 N/D SOLUTION FOR SINGULAR POWER POTENTIALS AND SINGULAR YUKAWA POTENTIALS. Misra, R. C.; Ross, W. R. (Univ. of New Brunswick, Fredericton). Lett. Nuovo Cim.; 4: No. 12, 571-4(22 Jul 1972).

The existence of an N/D solution for singular power potentials r^{-n} and singular Yukawa potentials exp $[-\mu r]r^n$, $n > 3$ and integer is studied by application of the Lyth theorem. The theorem of Lyth consists of imposing the condition of Holder continuity on the scattering phase-shift function $\delta(k)$ existing in potential scattering. (L.B.S.)

51926 SOLUTIONS OF THE FADDEEV EQUATIONS WITH LOCAL INTERACTIONS BY A VARIATIONAL PADE METHOD. Alabiso, C. (Univ., Parma, Italy. Istituto Nazionale di Fisica Nucleare, Milan); Botta, G.; Butera, P.; Prosperi, G. M. Lett. Nuovo Cim.; 4: No. 12, 561-70(22 Jul 1972).

A variational technique is considered for Faddeev equations with local potentials. The method exploits the connections which have been recognized between the Padi approximant technique and well-known variational methods which provide the solution of Lippmann-Schwinger type equations. The problem of the determination of the three-body bound states is mainly considered, adding only a brief sketch of the applications to the scattering problems. (L.B.S.)

51927 ASYMPTOTIC BEHAVIOR OF DUAL AMPLITUDES WITH MANDELSTAM ANALYTICITY. Atkinson, D. (Univ., Bonn); Contogouris, A. P.; Gaskell, R. Phys. Rev., D; 6: No. 4, 1070-82(15 Aug 1972).

The asymptotic ($|s| \to \infty$) behavior of a number of dual, crossing-symmetric amplitudes with nonzero Mandelstam double-spectral functions is studied. The difficulties in obtaining Regge behavior in the right-hand half of the s plane are analyzed in detail. (auth)

51928 BASIC DISCONTINUITY EQUATION. Cahill, Kevin E. (Wesleyan Univ., Middletown, Conn.); Stapp, Henry P. Phys. Rev., D; 6: No. 4, 1007-25(15 Aug 1972).

A formula is derived from field theory that expresses the discontinuity of any multiparticle scattering function across any normal threshold cut in terms of specified limits of scattering functions for other processes. The special case that expresses any inclusive cross section as a discontinuity has been used extensively in recent work on high-energy processes. Other cases of the general formula also appear to have important implications, which are briefly discussed. (auth)

51929 VOPROSY TEORII MNOGOKRATNOGO RASSEYANIYA CHASTITS. (Problems in the Theory of Multiple Scattering of Particles). Galishev, V. S. Moscow; Atomizdat (1972). 120p.

A series of boundary problems in the passage of γ quanta, electrons, and protons through matter is considered. The simplest boundary problem of particle in transit through a layer of a substance is given special attention. General approximation methods are utilized in solving kinetic equations, assuming the availability of an electronic computer. The fruitful method of Ivon—Mertens deserves wider use on the part of Russian workers. Useful polynomials and integrals are offered as aids in calculation. (K.S.W.)

51930 PHYSICAL UNITARIZATION OF INDIFINITE-METRIC THEORIES BY SHADOW STATE SUMMATION, BJORKEN SCALING AND LIGHT QUARKS. Nelson, C. A. (Louisiana State Univ., Baton Rouge). Lett. Nuovo Cim.; 4: No. 17, 913-18(26 Aug 1972).

It is shown how the standing-wave boundary condition of negative-metric states (previously suggested in order to unitarize the indefinite-metric theories) always leads to a scattering theory which is unitary and Lorentz invariant. Also the resultant form, based on the idea of standing wave states (quarks) can be easily used to unitarize the conventional pseudounitary S-matrix calculated from any indefinite-metric theory. (J.F.P.)

PHYSICS (LOW-TEMPERATURE)

51931 (COO-1098-42) LOW TEMPERATURE PHYSICS. Final Report. Dillinger, Joseph R. (Wisconsin Univ., Madison). 15 Jun 1972. 17p. Dep. NTIS.

The research referred to was performed from September 11, 1950, through June 15, 1972. Publications for the entire period are listed. Results are summarized under the following headings: the saturated and unsaturated superfluid ^{4}He film, specific heat of bulk liquid ^{4}He between 0.4 and 1.5°K, specific heat of solids, thermal conductivity, polymers, isotope effect in electrical superconductors, and instrumentation and techniques. Students trained in this work are listed and other educational aspects discussed. (M.H.R.)

Superfluidity

51932 APPROXIMATE DIAGONALIZATION OF THE ENERGY OPERATOR FOR A SYSTEM OF INTERACTING PARTICLES. Kushnirenko, A. N. (Inst. of Problems in Material Studies, Kiev). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 43-7 (1971). (In Russian).

One method for the diagonalization of the energy operator for a system of valence electrons was examined in the simplest models of a semiconductor and of a metal. The results obtained were used in the theory of superconductivity and the theory of superfluidity. (tr-auth)

51933 EFFECT OF BOUND STATES ON THE KAPITZA RESISTANCE FOR A FERMI-GAS MODEL OF LIQUID ^{3}He. Toombs, G. A. (Univ. of Nottingham, Eng.); Sheard, F. W.; Rice, M. J. Solid State Commun.; 10: No. 7, 601-3(1 Apr 1972).

Energy transfer between a solid and ^{3}He by adsorption—desorption processes can cause a substantial drop in the Kapitza resistance R_K at temperatures $\gtrsim$1°K. However, at lower temperatures this mechanism is restricted by the occupancy of the bound states and the limiting T^{-3} variation of R_K is not affected. (auth)

51934 VISCOSITY OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Kuenhold, K. A.; Crum, D. B.; Sarwinski, R. E. (Ohio State Univ., Columbus). Phys. Lett.; 41A: No. 1, 13-14(28 Aug 1972).

The viscosities of dilute solutions of ^{3}He in ^{4}He were measured between 0.03 and 0.6 K for molar fractions of ^{3}He between 0.005 and 0.07. The measured viscosities are in qualitative agreement with theory and do not exhibit the anomalously low values measured by others. (auth)

51935 PHONONS AND LAMBDA TEMPERATURE IN LIQUID HELIUM FOUR OBTAINED WITH THE SPIN MODEL. Scherer, Wolfgang D. Washington, D. C.; Catholic Univ. of America (1972). 64p. University Microfilms Order No. 72-21,803. Thesis.

A description of the quantum behavior of liquid He^4 is given in terms of the Matsubara—Matsuda lattice model. Particular attention is given to the kinematical interaction and to the hard core of the bosons. Instead of using a separate theory for the low-temperature behavior and for the lambda transition, these two concepts were united in one framework. Since the hard-core boson operators in the lattice model correspond to spin-one-half operators, one can interpret the hamiltonian as the hamiltonian of a magnetic system of oblate form, i.e., the x—y coupling is stronger than the z coupling. In order to obtain a prolate form, one introduces a rotation in the space of these operators. The resulting hamiltonian contains three parts: one part is of the anisotropic Heisenberg form (prolate), the second part contains a pair of creation operators at different lattice sites as well as a pair of annihilation operators at different sites, and the third part contains an interaction between creation (annihilation) operators and the z component of the spin operators. The third part of the hamiltonian is eliminated in the average with a particular choice of the rotation angle. This hamiltonian leads to a set of coupled equations of motion for the creation and annihilation operators. The decoupling is accomplished via a momentum-dependent Bogolyubov transformation. The solution of the coupled equations of motion leads to a linear energy spectrum and a self-consistent integral equation for the magnetization. An approximation of this self-consistency equation provides a temperature dependence of the magnetization and leads to a critical temperature for a range of external magnetic fields. It is found that the angle of rotation and the magnetization in the rotated frame exhibit a jump at the transition temperature. Consequently, the applied magnetic field for a given magnetization shows a kink at the transition temperature, i.e., the transition is of the second order. (Diss. Abstr. Int., B)

Superconductivity

Refer also to abstracts 51189, 51191, 51932, and 52271.

51936 (AD-737463) THEORY FOR SUPERCONDUCTIVITY IN D-BAND METALS. Bennemann, K. H.; Garland, J. W. (Rochester Univ., N. Y. Dept. of Physics and Astronomy. Illinois Univ., Chicago. Argonne National Lab., Ill.). 29 Nov 1971. Contract N00014-67-A-0398-0004. 37p. NTIS.

Superconductivity in transition metals, in transition metal alloys, in A15 compounds and in U6X compounds is studied within the framework of the BCS theory. The electron—phonon coupling constant lambda is expressed in terms of measurable normal-state quantities and an atomic parameter. Then, using the McMillan formula for the superconducting transition temperature T_c, the variation of T_c in the three transition metal series is discussed. Calculated values for T_c are given for several transition metal alloys, U6X compounds, and for Sc, Y, Lu, and La. Also it is shown that in A15 compounds, Cooper-pair fluctuations may occur even at temperatures several degrees K above T_c. (auth) (NTIS)

51937 (AD-737464) THEORY FOR THE PRESSURE DEPENDENCE OF T_c FOR NARROW-BAND SUPERCONDUCTORS. Garland, J. W.; Bennemann, K. H. (Rochester Univ., N. Y. Dept. of Physics and Astronomy. Illinois Univ., Chicago. Argonne National Lab., Ill.). 29 Nov 1971. Contract N00014-67-A-0398-0004. 40p. NTIS.

A theory for the pressure dependence of T_c in narrow-band superconductors is proposed. New physical mechanisms which, in transition metals, lead to an increase under pressure in the Hopfield parameter η and in some cases even an increase in T_c are discussed. It is shown how investigations of the pressure dependence of T_c may give information on the importance of lattice instability and/or spin fluctuations on T_c. Approximate calculated values of the partial derivative of T_c with respect to p are presented for all of the superconducting transition-metal elements and for a few compounds. (auth)

51938 (JINR-P13-6397) DEVICE FOR CHECKING THE EFFECT OF CHARGE EQUIVALENT FORMATION. Goncharov, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Apr 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of testing of the device at T = 4.2°K are described as well as its construction and parameters. The device was designed for checking the theoretically predicted effect of charge equivalent formation ("excessive" charge) in the insulated conductor after changing the current in it. A loop in the form of a double superconducting solenoid was wound bifilarly on a common frame and suspended inside the metallic cryostat using insulators. A thermal switch sensing element, controlling current in a closed circuit, and a total block diagram of the device are described. (auth)

51939 (LNF-72/28) MULTIPLY CONNECTED SUPERCONDUCTORS AND THE TUNNEL EFFECT. Baker, K.; Paterno, G.; Ricci, M. V.; Sacchetti, N.; Spagnoli, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 28 Mar 1972. 12p. Dep. NTIS (U. S. Sales Only).

The physical properties of a Type I superconducting cylinder are analyzed. The dependence of the order parameter on the external magnetic field and on the quantum number n is calculated. The expression for the induced current density, as a function of the order parameter and thus as a function of the external magnetic field and of the quantum number n, is presented. The properties of a superconducting cylinder are studied using the tunnel effect technique. The dependence of the zero-bias differential conductance on the external magnetic field and on the quantum number n, was computed for a tunnel junction of the superconductor/insulator/normal metal (S/I/N) type, in which the superconductor has a multiply connected geometry. (M.H.R.)

51940 HEAT CAPACITY OF SUPERCONDUCTING TERNARY MOLYBDENUM SULFIDES. Viswanathan, R. (Univ. of California, San Diego, La Jolla); Lawson, A. C. Science; 177: No. 4045, 267-8(21 Jul 1972).

The heat capacities of $AgMo_4S_5$, $PbMo_6S_7$, and $SnMo_5S_6$ are reported. These ternary molybdenum sulfides were found to be bulk superconductors with very large values of electronic heat capacity coefficients and very low values of Debye temperatures. (auth)

51941 LATTICE INSTABILITIES IN SUPERCONDUCTING TERNARY MOLYBDENUM SULFIDES. Lawson, A. C. (Univ. of California, San Diego, La Jolla). Mater. Res. Bull.; 7: No. 8, 773-6(Aug 1972).

Low temperature crystallographic and electrical resistivity data for several ternary molybdenum sulfides are presented. Some of these compounds are found to be crystallographically unstable. (auth)

51942 SUPERCONDUCTIVE TUNNELLING AND APPLICATIONS. Solymar, L. London; Chapman and Hall (1972). 406p.

The subject is dealt with in sections: a review of superconductivity and tunnelling; normal electron tunnelling (basic characteristics, special tunnelling effects, diagnostic applications, device applications); Josephson tunnelling (derivation of the basic equations, the Josephson effects, current-voltage characteristics, vortex solutions, Josephson junctions in parallel—the Mercereau effect, phenomena in rings containing one junction, fabrication, computer elements, generation mixing and detection of electromagnetic waves, voltmeters and magnetometers, determination of e/h, fluctuations). Additional material includes an extensive list of references, measurement results on SNS junctions, mechanical and superfluid analogues, microwave enhancement of superconductivity in weak links, various diagnostic and device applications, parametric amplification and relaxation oscillations. (UK)

51943 PHONON ANOMALIES IN TRANSITION-METAL CARBIDES. Smith, H. G. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett.; 29: No. 6, 353-4(7 Aug 1972).

The phonon anomalies observed in superconducting TaC have been explained recently by Weber, Bilz, and Schroeder (Phys. Rev. Lett., 28: 600(1972)) with their extended shell model. Their model also predicts an anomaly in the transverse acoustic mode in the [110] direction with xy polarization—a branch which was not measured in the initial neutron investigation. An experimental confirmation of the Weber–Bilz–Schroeder prediction, which gives added credence to their model, is reported and its possible significance discussed. (auth)

51944 CRITICAL CURRENTS IN A SUPERCONDUCTING WIRE MADE FROM DEFORMED NIOBIUM ALLOYS. Lazarev, B. G.; Lazareva, L. S.; Goridov, S. I. (Physical-Technical Inst., Kharkov). Dokl. Akad. Nauk SSSR; 203: No. 2, 329-31(11 Mar 1972). (In Russian).

Critical currents were measured at 4.2 and 2°K in a superconducting wire fabricated from deformed niobium-base alloys. The alloys tested were Nb–60 at.% Ti and Nb–25 at.% Ti–25 at.% Zr, used as free wire and wound into coils of various types. The critical current was determined as a function of the strength of the magnetic field. (K.S.W.)

51945 FLUX VORTICES AND TRANSPORT CURRENTS IN TYPE II SUPERCONDUCTORS. Campbell, A. M.; Evetts, J. E. (Cambridge Univ., Eng.). Advan. Phys.; 21: No. 90, 199-428 (Mar 1972).

The mechanisms by which Type-II superconductors can carry currents is considered. The equilibrium properties of the vortex lattice are described, and the generalized driving force in gradients of temperature and field is derived using irreversible thermodynamics. This leads to expressions for thermal cross effects which can include pinning forces. The field distributions which occur in a range of situations are derived and a number of useful solutions of the critical state given. In particular, the distribution in a longitudinal field is obtained, and the conditions under which force-free configurations can break down by the cutting of vortices discussed. The effects of lattice rigidity on the summation of pinning forces is considered and it is shown that a summation based on statistical arguments uses the same approximations and leads to the same results as a dissipation argument. Theoretical expressions are derived for the vortex pinning interaction to a number of different metallurgical defects. The theoretical models are compared critically with experimental measurements of pinning forces and other related phenomena, such as flux creep, low amplitude vortex oscillations and vortex lattice defect effects. The implications for technological materials are assessed. (auth)

51946 SUPERCONDUCTIVITY AND ITS APPLICATIONS TO POWER ENGINEERING. Hadlow, M. E. G. (Electrical Research Association, Leatherhead, Eng.); Baylis, J. A.; Lindley, B. C. Proc. Inst. Elec. Eng. (London); 119: No. 8R, 1003-32(Aug 1972).

The history of superconductivity is traced from its discovery in 1911 to the more recent developments of superconductors that are potentially useful in practical applications. The present state of knowledge of the theory of superconductivity is presented, and a summary of the exploitable properties of superconductors is given. The need for a low-temperature environment itself brings technological problems and the need for auxiliary equipment of reliability higher than at present exists, hence the evolution of specialized design practices and solutions. The state of development of a range of actual and potential applications of superconductors is assessed in terms of research magnets, electrical machines, cables, transformers, magnetic suspension, energy storage and others. It is concluded that, while the range of applications likely to be realized in commercial practice is perhaps less than that being advocated a few years ago, certain areas of development of large-scale electrical-engineering equipment employing superconductors will attract increasing interest and effort in the future. (auth)

51947 EXPERIMENTAL STUDIES OF WEAK SUPERCONDUCTIVITY. Kirschman, Randall Keenan. Pasadena, Calif.; California Inst. of Tech. (1972). 98p. University Microfilms Order No. 72-22,606.

Thesis.

Experimental investigations were made of the nature of weak superconductivity in a structure having well-defined, controllable characteristics and geometry. Controlled experiments were made possible by using a thin-film structure which was entirely metallic and consisted of a superconducting film with a localized section that was weak in the sense that its transition temperature was depressed relative to the rest of the film. The depression of transition temperature was brought about by underlaying the superconductor with a normal metal. The dc and ac electrical characteristics of this structure were studied. It was found that this structure exhibited a nonzero, time-average supercurrent at finite voltage to at least .2 mV, and generated an oscillating electric potential at a frequency given by the Josephson relation. The dc V–I characteristic and the amplitude of the ac oscillation were found to be consistent with a two-fluid (normal current-supercurrent) model of weak superconductivity based on a thermodynamically irreversible process of repetitive phase-slip, and featuring a periodic time dependence in the amplitude of the superconducting order parameter. The observed linewidth of the ac oscillation could be accounted for by incorporating Johnson noise in the two-fluid model. Experimentally it was found that the behavior of a short (length on the order of the coherence distance) weak superconductor could be characterized by its critical current and normal-state resistance, and an empirical expression was obtained for the time dependence of the supercurrent and voltage. It was found that the results could not be explained on the basis of theory of the Josephson junction. (Diss. Abstr. Int., B)

51948 TUNNELING CONDUCTANCE CURVES FOR THE SUPERCONDUCTING Pb-Mn SYSTEM. Chara, A. N.; Nagi, A. D. Singh (Univ. of Waterloo, Ont.). Lett. Nuovo Cim.; 4: No. 15, 794-6(12 Aug 1972).

It is pointed out that the tunneling conductance curves for superconducting, quench-condensed, Pb–Mn films can be understood by assuming that in these films the conduction electron–magnetic impurity interaction is strong. The Kondo temperature of this system is estimated to be 0.07°K. (M.H.R.)

51949 SUPERCONDUCTIVITY AND SUPERCONDUCTING MATERIALS. Livingston, J. D. (General Electric Research and Development Center, Schenectady, N. Y.). Can. Met. Quart.; 11: No. 2, 285-94(1972).

Present understanding of the properties of high-field superconductors, specifically critical temperature, critical field, and critical current, is reviewed. The processing of commercial materials is described, and present and future applications are discussed. (auth)

51950 QUASIFIELD IN SUPERCONDUCTORS AND INCREASE OF T_c UNDER NON-EQUILIBRIUM CONDITIONS. Aronov, A. G.; Gurevich, V. L. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 15: No. 9, 400-3(5 May 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 9, 564-7(5 May 1972).

The superconducting transition is a second-order phase transition analogous to the transition in magnetically ordered systems. When an external magnetic field is applied to a ferromagnet, the phase transition vanishes, and the ordering parameter (the magnetization) remains different from zero at all temperatures. It is shown that an analog of this external field, a quasifield, can exist under nonequilibrium conditions. A semiconductor or semimetal band scheme under the influence of light is examined. (M.H.R.)

Equipment and Devices

Refer also to abstracts 51206 and 51939.

51951 (ANL/HEP-6810) SUPERCONDUCTING MAGNET TECHNOLOGY. PART II. Laverick, Charles (Argonne National Lab., Ill.). May 1968. 106p. Dep. NTIS.

The following topics are covered: important coil characteristics, supermagnet types, magnet and conductor performance characteristics, stability and stabilization, materials characteristics, the behavior of copper in liquid helium, coil diagnostics, magnet materials and conductors, magnet focussing, further significant magnets, large bubble chamber magnets, beam transport magnets, polarized proton targets, a high current density solenoid for a neutron and proton spin experiment at the L.R.L. 184-inch cyclotron, thermonuclear fusion research, electron microscopy, estimated operating characteristics for various magnet types, problem areas, and possibilities for the future. (53 figures. 10 tables. 12 references.) (M.H.R.)

51952 (LA-DC-72-724) VIBRATION SIMULATION OF A SPACE PROBE MODEL, SUPERCONDUCTING ENERGY STORAGE COIL. Rogers, John D. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 15p. (CONF-720803-5). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO. (9 Aug 1972).

The superconducting inductive energy storage coil described operated in the persistent mode for all the tests without going normal. The experiment indicates, within the limitations of the model, that the superconductor and winding techniques used have a high probability of successful application in the fabrication of higher-energy-storage coils. (M.H.R.)

51953 (LBL-498) EXTERNALLY SHUNTED JOSEPHSON JUNCTIONS. Hansma, Paul Kenneth (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1972. Contract W-7405-eng-48. 78p. Dep. NTIS.

Thesis.

The behavior of a new type of quantum device, an externally shunted thin film Josephson junction, was investigated. Using Sn/I/Sn shunted junctions, the Stewart–McCumber predictions were experimentally verified for the current–voltage (I–V) characteristics of a generalized weak link treated as a lumped circuit consisting of an ideal Josephson junction with critical current i_c, conductance G, and capacitance C. In addition, it was shown experimentally that the predictions for the amount of hysteresis, characterized by the parameter $\alpha = i'/i_c$, which is the ratio of the zero-voltage current intercept for decreasing current to the critical current i_c, as a function of the dimensionless circuit parameter $\beta_C = [(2e/\hbar)(i_cC/G^2)]$ are exact in the zero-inductance limit. The shunt inductance can be treated by replacing C with reduced effective capacitance C′. An externally shunted Josephson junction acts as an adjustable weak link, whose hysteresis parameter, α, can be varied over the whole range $0 \lesssim \alpha \lesssim 1$ to reproduce the behavior of many other types of weak links. In fact, if the temperature of a single shunted junction is varied between 1.12 and 3.7 K, or the applied magnetic field is varied between 0 and 1 Oe, β_C can be varied over two orders of magnitude while the junction is in the cryostat. Since β_C determines the qualitative nature of the I–V characteristic, this variation of β_C simulates widely different types of weak-link devices. Furthermore, the accessible range of β_C for the single shunted junction can be changed while it is out of the cryostat by altering its external shunt conductance. Thus, externally shunted Josephson junctions are theoretically well-understood models of, and simulators for, the behavior of many weak-link junctions; they have the desirable property of adjustability both before and after cryostat installation. This versatility should find many significant applications. (auth)

51954 THEORY OF THE THERMAL CONDUCTION ANOMALIES OBSERVED IN THIN METAL FOILS AT LOW TEMPERATURES. Seiden, Joseph (Univ., Paris, Orsay, France). Compt. Rend., Ser. A; 274: No. 20, 1111-14(15 May 1972). (In French).

Recent measurements carried out on thin metal foils separating baths of superfluid helium at different temperatures indicate energy flux transfers lower than those resulting from the Kapitza resistance. It is shown that in addition to the Kapitza resistance, two other resistances also come into play in reducing the energy transfer at low temperatures in metals: electron–phonon interaction and electronic thermal resistivity. (France)

51955 SIMPLIFIED ADJUSTABLE SQUID. King, C. A. (Loyola Univ., New Orleans). Rev. Sci. Instrum.; 42: No. 11, 1717-18(Nov 1971).

The construction of a point-contact superconducting quantum interference device (SQUID) is described. The construction technique is simplified and results in a very stable, rugged device. (auth)

51956 SENSITIVITY ENHANCEMENT OF SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES THROUGH THE USE OF FRACTIONAL-TURN LOOPS. Zimmerman, J. E. (National Bureau of Standards, Boulder, Colo.). J. Appl. Phys.; 42: No. 11, 4483-7(Oct 1971).

A new fractional-turn configuration for superconducting quantum interference devices provides enhanced sensitivity, with large loop area and low loop inductance. By operating the new configuration at optimum bias frequency (300 MHz or higher), inherent field sensitivities of 10^{-15} T (10^{-11} G) or better can reasonably be expected. The operational sensitivity of an instrument using such a device would probably be limited by externally generated noise in most applications. The configuration is readily adaptable to measurements of both diagonal and off-diagonal components of the field gradient. (auth)

51957 NONLINEAR EFFECTS IN SUPERCONDUCTING RESONATORS. Bychkova, N. N.; Kulik, I. O. (Physical-Technical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 3, 461-6(Sep 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 3, 584-90(Mar 1972).

The problem of harmonic generation is considered in a superconducting resonator for large amplitudes of the high-frequency field and with a constant magnetic field parallel to the surface. Although the conversion factor is small for single reflection of a wave from the superconductor ($R_m \sim 10^{-8}-10^{-10}$), the overall harmonic conversion factor is determined by the product QR_m (where Q is the quality factor) and can reach 1% under certain conditions. (auth)

51958 FLUCTUATION SPECTRUM IN SUPERCONDUCTING POINT JUNCTIONS. Likharev, K. K.; Semenov, V. K. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 15: No. 10, 442-5(20 May 1972).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 15: No. 10, 625-9(20 May 1972).

An attempt is made to find the spectral density of the fluctuations of the voltage V(t) across a point junction (or a bridge of small dimensions), for which the model developed by Aslamov and Larkin is valid. (M.H.R.)

PHYSICS (NUCLEAR)

51959 (ORNL–4800) NEUTRON PHYSICS DIVISION. Annual Progress Report for the Period Ending May 31, 1972. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 98p. Dep. NTIS.

CARBON-12 — proton reactions (p,xp) at 61.9 MeV, differential cross sections for, (E)
FAST TEST REACTOR — cooling system for, neutron streaming in ducts of
INFORMATION CENTERS — activities of Radiation Shielding Information Center
NEUTRON CROSS SECTIONS — data files on thermal capture, comparison of published data and ENDF/B III
  — data files on secondary gamma production, comparison of published data and ENDF/B III
OAK RIDGE ELECTRON LINEAR ACCELERATOR — operation of, status report on
RADIATION DETECTORS, SCINTILLATION (LIQUID) — response function of NE-213, for 15- to 61.5-MeV neutrons
RADIATION DETECTORS, SCINTILLATION (SOLID) — meson (π^-) energy deposition in shower-type
  — meson (π^-) energy deposition in total absorption NaI(Tl)
RADIATION DETECTORS, SHOWER — meson(π^-) energy deposition in scintillation
RADIATION DOSIMETERS, THERMOLUMINESCENT — response function for albedo neutrons
TISSUES — radiation dose to, intermediate energy π-meson
URANIUM-235 — neutron fission of, pulse height spectra from, (E) (J.W.R.)

Neutron Interactions with Matter

Refer also to abstracts 50677, 51176, 51586, and 52631.

51960 (AEC-tr–7138, pp 1-8) INFLUENCE OF SELF-SHIELDING AND NEUTRON FLUX PERTURBATION EFFECTS ON THE ACTIVATION OF SAMPLES BY THERMAL NEUTRONS. Zharkov, V. A. Translated from Radiats. Tekh.; No. 3, (1969).

In general, the perturbation coefficient and the neutron flux distribution within the sample change as a function of time as a result of the generation of secondary isotopes; however, the self-shielding and perturbation coefficients and the flux distribution in the bulk of the sample will not change with time in the case of samples with a low probability of absorption, provided that the macroscopic absorption cross section remains virtually constant. In practice, this corresponds to the formation of short-lived isotopes. The effect of self-shielding and perturbation is to reduce the neutron flux on the surface of a sample from what it was at that point in space before insertion of the sample. Expressions for the self-shielding and flux perturbation coefficients, derived from the solution of the kinetic equation, are given, along with data for their evaluation for cylindrical, spherical, and arbitrary geometry. The expressions yielded good agreement with experiment. (2 figures, 2 tables) (R.W.R.)

51961 (AEC-tr–7138, pp 8-12) EXPERIMENTAL INVESTIGATION OF THE ACTIVATION OF SPHERICAL AND CYLINDRICAL SAMPLES IN THERMAL-NEUTRON FIELDS. Zharkov, V. A.; Terent'ev, V. P.; Fradkin, G. M. Translated from Radiats. Tekh.; No. 3, (1969).

An expression for the saturation activity of a spherical sample by thermal neutrons was obtained. The validity of the expression was checked experimentally for spherical and cylindrical samples by determining the values of $F = G \times H$, where G is the self-shielding activation factor and H is the flux perturbation coefficient. The samples, in the form of thin-walled Plexiglas shells filled with aqueous solutions of $In(NO_3)_3 \cdot 3H_2O$, were irradiated in water-filled cylindrical vats with a diameter of 90 and height of 100 cm by using three Po–Be sources. It was found that the theoretical and experimental data showed good agreement for the case of the sphere and that, within the experimental accuracy, the perturbation factors for spheres and cylinders are the same. The effect of neutron scattering on the results was found to be negligible. (1 figure) (R.W.R.)

51962 (AEC-tr–7138, pp 182-90) SYSTEM FOR SLOWING DOWN FAST NEUTRONS WITH EXTRACTION OF DIRECTIONAL NEUTRON FLUXES. Bukarev, V. A.; Kazachenkov, Yu. N.; Shtan, A. S.; Yaskevich, V. S. Translated from Radiats. Tekh.; No. 3, (1969).

A shielding–moderating system was built for the study of problems associated with the thermalization of fast neutrons from T(d,n) neutron generators. Several horizontal channels were built in the moderating system at various distances from the center to enable extraction of beams with different energy spectra. The effect of internal cavities on the changes in the neutron density within the moderating system was assessed, the neutron fluxes at the channel exits and their energy spectra were measured, and the relation between channel parameters and the emerging flux was studied. For two of the channels the emerging fluxes were measured as a function of the collimator diameters; it was found that the flux was proportional to the square of the channel radius (within experimental error). (7 figures, 1 table) (R.W.R.)

51963 (COO–3058-20) IRON-FILTERED NEUTRON BEAMS: A NEW APPROACH TO PRECISION TIME-OF-FLIGHT CROSS SECTION MEASUREMENTS. Block, R. C.; Kaushal, N. N.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1972. 4p. (CONF-720901–10). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

The use of thick filters in a white source time-of-flight neutron beam for obtaining low-background bands of transmitted neutrons for cross section measurements is studied. Relative neutron intensities near 24 keV are plotted for neutrons filtered by 2, 8, 14, and 20 inches of Armco iron. Results are presented for neutron capture counting rates vs. neutron energy for depleted uranium and tantalum using an 8 inch iron filter. This technique allows accurate effective cross section measurements over a narrow energy interval. (W.H.K.)

51964 (IAE–2110) HIGH-SPEED MODIFICATIONS OF THE METHOD OF PROBABILITIES OF THE FIRST COLLISION. PART I. Solodov, A. F. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

High-speed algorithms were investigated for the calculation of the distribution of monoenergetic neutrons in a multilayered cylindrical cell by the first collision probability method. A brief survey and a critical evaluation of known approximation methods are given. A new high-speed scheme, which yields practical, accurate results, is presented in report IAF–2111. A series of programs is given, and some of the suggested algorithms are put into practice in report IAE–2112. (2 figures, 3 tables) (tr-auth)

51965 (IAE–2111) HIGH-SPEED MODIFICATIONS OF THE METHOD OF PROBABILITIES OF THE FIRST COLLISION. PART II. Solodov, A. F. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 27p. (In Russian). Dep. NTIS (U. S. Sales Only).

In this successor to Part I (Preprint IAE-2110) the so-called "TL-modification" for calculating P_{ij} in a multilayered cylindrical cell is elucidated. A comparison with the results of other work showed that the use of this modification in the VPS method leads to a practical accurate distribution of one-velocity currents in the area of the cell. (4 figures, 4 tables) (tr-auth)

51966 (IAE–2112) HIGH-SPEED MODIFICATIONS OF THE METHOD OF PROBABILITIES OF THE FIRST COLLISION. PART III. Solodov, A. F. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 32p. (In Russian). Dep. NTIS (U. S. Sales Only).

Polynomial coefficients were tabulated which approximate the functions $P^{ia}(x,z)$ and $L^{ia}(x,z)$. Program descriptions and listings are presented, and solutions to problems previously posed are given (See Part I- Preprint IAE-2110, and Part II- Preprint IAE-2111). (6 tables) (tr-auth)

51967 (IEA–255) REDUCTION OF SECOND ORDER NEUTRON CONTAMINATION BY A TELLURIUM RESONANCE FILTER. Fulfaro, R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec 1971. 9p. Dep. NTIS (U. S. Sales Only).

In order to reduce the neutron second order contamination effect in a resonance measurement a technique which makes use of a tellurium filter was developed and the iridium resonance at $E_0 = 0.654$ eV was chosen as standard. Tellurium has the necessary properties for a good filter since its neutron cross section is low and constant near the energy E_0 and has a resonance near the energy 4 E_0. Calculation of the second order contamination effect from (111) planes of an aluminium single crystal was made for the iridium resonance affected by Doppler broadening and instrumental resolution. The efficiency of the tellurium filter was calculated as a function of neutron energy and an expected curve for the iridium resonance was obtained; the agreement with the experimental points measured with filtered beam indicates that the utilization of this type of filter permits to perform accurate nuclear resonance measurements in this energy range. (auth)

51968 (JAERI-Memo-4047) HIGHER-ORDER CONTAMINATIONS IN A LiF(111) NEUTRON MONOCHROMATOR. Asami, Tetsuo; Ideno, Kazumi; Okamoto, Koichi; Ohno, Yoshihisa (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

The higher-order contaminations for the LiF(111) in the JAERI neutron crystal spectrometer have been measured and compared with the calculated values. The experimental values of the second- and third-order contaminations were obtained from the neutron transmissions for gold, boron; and samarium filters in the neutron energy range below ~0.06 eV, and for cadmium filters in the energy range above ~0.06 eV. The calculated order-contaminations were obtained by the same method as Hass and Shore's using the measured spectrum of neutron counting rate and the calculated reflectivity for the LiF(111) crystal. The observed higher-order contamination for the LiF(111) was considerably large compared with the calculated values. However, all the calculated values normalized to the experimental values at 0.185 eV were in good agreement with the experimental ones in the energy range above ~0.06 eV for both the second- and third-order contaminations. (auth)

51969 (LA-DC-72-734) SENSITIVITY OF CALCULATED PULSED SPHERE SPECTRA AND NEUTRON AGE TO CARBON CROSS SECTIONS. Weisbin, C. R.; Seamon, R. E.; Harris, D. R.; Stewart, L.; LaBauve, R. J.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex.). [nd]. 11p. (CONF-720901-1). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

In order to evaluate the adequacy of the present ENDF/B-III carbon data file (MAT1165) a series of Monte Carlo calculations were performed for both fission and monoenergetic sources. The results for neutron age and higher spatial moments are compared with other available experimental and theoretical values. The present computations were made with the ETOPL processor and the MCN Monte Carlo code. All measurements give consistently higher values for age than the calculations reported here. The precise value of the fission age is clearly sensitive to the total cross section in the keV region and below. There are no measurements or recent calculations published using ENDF/B-III data for the 14 MeV age in carbon with which to compare the present result. The value is markedly dependent upon the representation of the secondary energy distribution from the (n,n′3α) reaction, and, to a lesser extent, to the description of inelastic angular distributions. To further investigate the suitability of MAT1165 for transport calculations involving finite media, the LLL 2.9 mfp pulsed sphere experiment was calculated. All of the detail observed in the experiment is faithfully reproduced, however the calculations still lie significantly below the experimental curve. The effect of inelastic anisotropy can be clearly observed. (auth)

51970 (ORNL-4741) STUDY OF THE EFFECT OF SOURCE ASYMMETRY ON TIME-DEPENDENT NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN AIR. McGregor, B. J.; Straker, E. A. (Oak Ridge National Lab., Tenn.). Feb 1972. Contract W-7405-eng-26. 131p. Dep. NTIS.

The effects of several asymmetric sources on time-dependent and steady-state transport calculations for both 12.2- to 15-MeV and fission-neutron sources in air were determined. The response functions considered were air kerma, nonionizing silicon kerma, and tissue dose for neutrons, and air kerma, silicon kerma, and tissue dose for gamma rays. Monte Carlo calculations were made to determine the time-dependent responses. Adjoint discrete ordinates results were obtained to compare with the time-integrated Monte Carlo data. The use of the one-dimensional adjoint solution to investigate source asymmetry effects is discussed in detail. (auth)

51971 (ORNL-TM-3864) EFFECTS OF AIR-DENSITY PERTURBATIONS ON THE TRANSPORT OF NEUTRONS AND SECONDARY GAMMA RAYS PRODUCED BY POINT NEUTRON SOURCES. McGregor, B. J.; Abbott, Lorraine S. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 29p. Dep. NTIS.

A series of MORSE Monte Carlo calculations were performed to determine the effect that changes in the air density produced by one weapon detonation would have on the transport of radiation produced by a second weapon detonated within the next few seconds. The responses of interest were the displacement and ionization that would be induced in silicon by neutrons and secondary gamma rays respectively in the vicinity of the first burst. Two density profiles around the first burst were used, corresponding to times of 1 and 3.16 sec after the burst. Three neutron emission spectra were used for the second weapon, one consisting of 14-MeV neutrons alone and the other two consisting of typical thermonuclear and ^{235}U fission spectra. In all cases the medium was assumed to be infinite air, and spherical geometry was employed with the origin at the center of the first detonation. The responses were calculated for eight distances from the second source in the direction of the first source within seven (or nine) solid angles measured from an axis passing through both sources. For the 3.16-sec density profile and source separation distances of 1100 and 1500 m the density perturbation effects at the points of interest were small. The effects were much more pronounced for the 1-sec profile, which is partially due to the two sources being closer together (0 to 800 m). With the 1-sec profile all neutron responses calculated for positions immediately beyond the first burst were about 50% higher than those obtained at the same positions in the unperturbed atmosphere; lesser increases were obtained as the angle from the axis of symmetry was increased. The secondary gamma-ray responses also were higher, with the increases being approximately one-half of the increase in the neutron responses for the same positions. For the case of the two detonations occurring at the same position, the neutron responses between 1000 and 1500 m were about 20% higher than those in the unperturbed atmosphere and the gamma-ray responses were 10% higher. (auth)

51972 GROUP-COLLAPSING PROBLEM FOR MULTIGROUP CROSS SECTIONS. Cuculeanu, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 4, 477-84(1972). (In Rumanian).

Topics discussed include the flux-weighting collapsing scheme, the perturbation collapsing scheme, a collapsing method with optimal neutron group structure, and empirical adjustment of group cross sections. (J.N.R.)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 51594, 51640, 51701, 51989, 52010, 52032, 52068, 52072, and 52079.

51973 QUADRUPOLE MOMENT OF THE DEUTERON. Reid, R. V. Jr.; Vaida, M. L. (Univ. of California, Davis). Phys. Rev. Lett.; 29: No. 8, 494-6(21 Aug 1972).

The electric field gradient in the HD and D_2 molecules was calculated from 87-term wave functions of the James and Coolidge type. With the use of experimental values of the quadrupole interaction constant, the electric quadrupole moment of the deuteron is found to be 0.2875 F^2, which is 2% larger than the most recent values. The estimated error is 0.002 F^2. (auth)

51974 THREE-NUCLEON BOUND STATE FROM FADDEEV EQUATIONS WITH A REALISTIC POTENTIAL. Gignoux, C.; Laverne, A. (Institut des Sciences Nucleaires, Grenoble, France). Phys. Rev. Lett.; 29: No. 7, 436-8(14 Aug 1972).

A method for solving Faddeev equations in configuration space is used to study the state of three nucleons bound in a Reid potential. Including D states for the spectator particle gives a binding energy of 6.6 MeV, probabilities $P_{S'}$ = 1.9% and P_D = 7.9%, and a charge radius $r_c(^3He)$ = 1.97 fm; the dip in the charge form factor is found at q^2 = 14.5 fm^{-2}. (auth)

51975 DIFFERENTIAL CROSS SECTIONS FOR SMALL-ANGLE SCATTERING OF 24-MeV NEUTRONS BY PROTONS. Masterson, T. G. (Univ. of Wisconsin, Madison). Phys. Rev., C; 6: No. 3, 690-700(Sep 1972).

Absolute n−p elastic scattering cross sections were measured at 19.5 and 25.1° (lab) for an incident neutron energy of 24 MeV. A liquid scintillator detected both the incident and scattered neutrons. The scatterer was a liquid scintillator also. The c.m. differential cross sections were 31.3 ± 0.5 and 30.7 ± 0.6 mb/sr at c.m. scattering angles of 39.3 and 50.5°, respectively. The present results agree with the cross sections predicted by Hopkins and Breit. (auth)

51976 SIMPLE ESTIMATE OF THE ATTENUATION OF QUASIFREE SCATTERING IN NUCLEON-DEUTERON BREAKUP. Rogers, J. G.; Saylor, D. P. (Texas A and M Univ., College Station). Phys. Rev., C; 6: No. 3, 734-8(Sep 1972).

A semiclassical model was developed to estimate the attenuation of quasi-free scattering in nucleon−deuteron breakup. According to this model the probability that an initial quasi-free scattering event undergoes multiple scattering is just the probability that one or the other of the emerging high-energy particles strikes the spectator particle before leaving the volume of space occupied by the target deuteron. The model yields directly a prediction for the probability of such a rescattering for events in which the nucleons in the deuteron are far apart. An approximate form is assumed for the short-range behavior of this rescattering probability. With this approximation the predictions of the model for the peak value of the D(p,2p)n cross section agree well with experiment in the energy range 20 to 50 MeV, and the predicted energy spectrum at $E_p = 45$ MeV agrees with experiment in both size and shape. (auth)

51977 REACTIONS (p,pd) AND (p,2p) ON ^{3}He AT 590 MeV. Kitching, P. (Univ. of Alberta, Edmonton); Moss, G. A.; Olsen, W. C.; (and others). Phys. Rev., C; 6: No. 3, 769-72(Sep 1972).

The reaction ^{3}He(p,pd) was studied for recoil momenta of the spectator proton up to 230 MeV/c. The cross section of ^{3}He(p,2p) was measured up to 100 MeV/c. The results are interpreted in terms of the plane-wave impulse approximation, and the form factors for $^3\mathrm{He} \rightarrow$ dp and $^3\mathrm{He} \rightarrow$ p(pn) are compared with a calculation of the ^{3}He wave function in which the two-nucleon interaction is described by a separable potential that reproduces the low-energy properties of the two-nucleon system. (auth)

51978 PROTON–PROTON BREMSSTRAHLUNG CALCULATIONS AT UNEQUAL ANGLES IN THE COPLANAR GEOMETRY. Brown, V. R. (Univ. of California, Livermore). Phys. Rev., C; 6: No. 3, 1110-12(Sep 1972).

Proton–proton bremsstrahlung cross sections are calculated for the Bryan–Scott III and the Hamada–Johnston potentials, and compared with a recent experiment at 156 MeV with forward coplanar asymmetric geometry. The cross section for unequal angles involves a simple extension of earlier results. The calculations include rescattering but do not include Coulomb effects. Also presented is a ppγ calculation at 65 MeV (25, 35°) in comparison with experiment and other calculations. At 156 MeV there is some experimental agreement, but the trend with increasing inclusive angle between the outgoing protons is in the wrong direction. The results at 65 MeV are consistent with experiment. (auth)

51979 CHARACTERISTICS OF PION AND NUCLEON INTERACTIONS WITH NUCLEI AT ENERGIES GREATER THAN 2 x 10^{11} eV. Abdullaev, A. M.; Azimov, S. A.; Beisembaev, R. U.; Yuldashbaev, T. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 50-3(1971). (In Russian).

Experiments were conducted on the interaction of nucleons and pions with light nuclei in order to obtain data on the ratio of charged/neutral particles and on the distribution of the multiplicity of secondary particles. The target consisted of three layers of paraffin separated by air spaces; a spark chamber recorded the charged particles. The ratio sought of charged/neutral particles = 2.4 ± 0.4, and the average value of the multiplicity of secondary particles during the interaction of neutrons with paraffin nuclei $\langle n_s \rangle_N = 8.7 \pm 0.6$. For pion–paraffin nuclei interaction, $\langle n_s \rangle_\pi = 9.0 \pm 1.0$. (2 figures) (K.S.W.)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 51176, 51818, 51979, 51994, 52002, 52010, 52034, 52042, 52083, and 52287.

51980 (ANL–7938) NEUTRONS FROM PROTON BOMBARDMENT OF NATURAL LITHIUM. Meadows, J. W.; Smith, D. L. (Argonne National Lab., Ill.). Jun 1972. Contract W-31-109-eng-38. 16p. Dep. NTIS.

The ^{7}Li(p,n)^{7}Be reaction is used extensively as a source of fast neutrons. Below 2.38-MeV proton energy, the reaction proceeds only to the ^{7}Be ground state and produces a single neutron group. At higher energies, other neutron-producing reactions can occur, and they must be considered in the analysis of many experimental results. This report collects and summarizes some of the properties of this neutron source that may be useful in the reduction of experimental data. Included are the neutron-yield-versus-proton-bombarding energy, group fractions for the principal neutron-producing reactions, approximate forward-angle angular distributions, and information on neutron-energy spectral distributions. These data have been collected from the literature and supplemented with explicit measurements. (auth)

51981 (BNL-tr–495) NEUTRON CROSS SECTIONS OF ISOTOPES USED AS ABSORBERS IN ATOMIC REACTORS. Vertebnyi, V. P.; Vlasov, M. F.; Gnidak, N. L.; Kolotyii, V. V.; Kirilyuk, A. L.; Pavlenko, E. A.; Pasechnik, M. V.; Razbudei, V. F.; Fedorova, A. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Second International Conference on Nuclear Data for Reactors, Helsinki, June 15–19, 1970. 36p. (CONF-700605–14). Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 15096. (auth)

51982 (COO–2167-1) CYCLOTRON LABORATORY ANNUAL REPORT, MARCH 1, 1971–May 1, 1972. (Michigan Univ., Ann Arbor. Cyclotron Lab.). May 1972. Contract AT(11-1)-2167. 79p. Dep. NTIS.

CARBON-12—carbon-12 reactions at 125 MeV, spectra from, (E)
CYCLOTRONS—experimental facilities at University of Michigan, development of
DYSPROSIUM-162—deuteron reactions (d,p) at 29 MeV, proton spectra from, (E)
—alpha reactions (α,t) at 45 MeV, triton spectra from, (E)
DYSPROSIUM-164—proton reactions (p,2nγ) at 15 MeV, γ spectra from, (E)
GADOLINIUM-158—alpha reactions (α,t) at 45 MeV, triton spectra from, (E)
GADOLINIUM-160—proton reactions (p,2nγ) at 15 MeV, γ spectra from, (E)
HOLMIUM-163—energy-level scheme from (p,2nγ) reactions, (E)
MAGNESIUM-26—deuteron reactions (d,p) with, deformation effects on angular distributions for, (E)
NUCLEI—isotope shift coefficients for N = 40 to 130
OXYGEN-16—deuteron reactions (d,p) at 29 MeV, angular distributions for, (E)
PRASEODYMIUM-141—alpha reactions (α,2nγ) at 28 MeV, γ spectra from, (E)
PRASEODYMIUM-143—energy-level scheme from praseodymium-141 (α,2nγ) reactions, (E)
RADIATION DETECTORS, SCINTILLATION (LIQUID)—development of array of, for neutron time-of-flight studies
RADIATION DETECTORS, SEMICONDUCTOR—development of array of position-sensitive
RUBIDIUM-87—energy levels from strontium-88 (d,p) reactions, spectroscopic factors for, (E)
—deuteron reactions (d,p) at 29 MeV, proton spectra from, (E)
TERBIUM-159—energy-level scheme from (p,2nγ) reactions, (E)
THALLIUM-203—alpha inelastic scattering at 45.5 MeV, α spectra from, (E)
THALLIUM-205—alpha inelastic scattering at 45.5 MeV, α spectra from, (E)
—alpha reactions (α,4nγ) at 45 MeV, γ spectra from, (E)

51983 INELASTIC ELECTRON SCATTERING FROM ^{16}O. Kim, Jong Chan. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1971). 156p. University Microfilms Order No. 72-18,651. Thesis.

The 140-MeV Saskatchewan electron linear accelerator was used to measure inelastic electron scattering cross sections for ^{16}O. The low-lying levels, e.g., those at 11.52 MeV (2^+, T = 0), 12.05 MeV (0^+, T = 0), 12.53 MeV (2^-, T = 0), 12.96 MeV (2^-, T = 1), and 12.10 MeV (1^-, T = 1), were studied. The transition matrix elements for these levels obtained in the momentum transfer range $0.2 < q^2 < 0.9$ fm^{-2} were derived from the experimental cross section in the first Born approximation. The above momentum transfer range bridges the gap between the data obtained at high q and the data of the low-q region. With an improved resolution, the 12.96-MeV and 13.01-MeV levels were resolved. Also, the longitudinal and transverse components of transition matrix elements were separated. Use of a gas target, operating at low pressure, enabled an upper limit to be set on the magnetic monopole (0^-) level at 12.07 MeV; the finely resolved level structure in the 13-MeV region was seen. The ground-state radiative widths were determined by extrapolation to low momentum transfer and compared with previous results obtained by both electron scattering and other experiments. The odd-parity states are compared with the particle–hole model predictions generated from Gillet's wave functions. For the even parity levels, as has been already pointed out by others, the pure-shell-model description in a spherical well does not fit the experimental data. The generalized Helm model, which is a collective model, fitted the 11.5-MeV (2^+) level fairly well. The form factor for this level obtained from the Brown and Green wave functions in the SU3 limit has a good diffraction minimum, but the magnitude is only $\frac{1}{5}$ that required. However, it is expected to yield almost the right size when the potential is triaxially deformed, as was found for the 12.02-MeV (0^+) level. (Diss. Abstr. Int., B)

51984 PARTIAL TRANSITIONS IN MUON CAPTURE BY COMPLEX NUCLEI. I. THE CAPTURE RATE. Bukhvostov, A. P.; Chatrchan, A. M.; Dogotar, G. E.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B3: No. 3, 375-83(1972).

The partial capture rates in muon capture by some light nuclei (^{9}Be, ^{10}B, ^{13}C, ^{14}N, ^{15}N, and ^{19}F) are calculated. The dependence of capture rates on nuclear structure is investigated. The possibility of deriving muon-nucleon coupling constants from data on light nuclei is discussed. (auth)

51985 FAST π-MESON SCATTERING BY NUCLEI. Sitenko, A. G.; Dotsenko, I. S.; Fursa, A. D. (Inst. of Theoretical Physics, Kiev. Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1676-84(Oct 1971). (In Russian).

On the basis of the multipole formalism, fast π-meson scattering by nuclei is considered. The impulse approximation was used. The pion-nucleon interaction amplitude is chosen according to the experimental data on π-meson scattering by free nucleons. Numerical calculations were carried out for angular distributions for negative π-meson elastic scattering by ^{12}C nuclei as well as for inelastic scattering with excitation of the level 2^+, T-0 (4.44 MeV) of ^{12}C nucleus. Good agreement is obtained with the experimental data in a wide energy range. (auth)

51986 FIRST 0^+ EXCITED STATE OF ^{16}O IN THE α-PARTICLE MODEL OF LIGHT NUCLEI. Avishai, Y. (Argonne National Lab., Ill.). Phys. Rev., C; 6: No. 3, 677-9(Sep 1972).

The pole approximation that Narodetskii introduced into the theory of four-particle scattering is here applied to ^{16}O, which is assumed to be composed of four structureless α particles. The binding energy of the excited 0^+ state of ^{16}O was calculated by using an Irving variational wave function for the ground state of ^{12}C and taking both Yukawa and exponential $\alpha\alpha$ potentials. In the light of earlier theoretical results on ^{12}C, comparing the present results with experiment suggests that, at least for calculation of the bound states, the α-particle model of ^{16}O is reasonable. (auth)

51987 SOME PROPERTIES OF THE LOWEST T = 2 STATES IN ^{16}O. Nero, A. V.; Pixley, R. E.; Adelberger, E. G. (Stanford Univ., Calif.). Phys. Rev., C; 6: No. 3, 679-84(Sep 1972).

A state at 22.722 ± 0.005 MeV excitation in ^{16}O, with a width of 12.5 ± 2.5 keV, was observed as a resonance in the ^{14}N + d and ^{12}C + α reactions. The level is assigned $J^\pi = 0^+$ on the basis of excitation functions for the reaction $^{12}C(\alpha,\alpha_2)^{12}C$ measured at various angles, and is presumed to be the T = 2 state reported at this energy. Several partial widths are obtained. (auth)

51988 CROSS SECTIONS FOR ^{6}Li AND ^{7}Li PRODUCTION FROM THE BOMBARDMENT OF ^{12}C BY 150- AND 600-MeV PROTONS AND 880-MeV ALPHA PARTICLES. Raisbeck, G. M.; Lestringuez, J.; Yiou, F. (CNRS, Orsay, France). Phys. Rev., C; 6: No. 3, 685-90(Sep 1972).

The cross sections for ^{6}Li and ^{7}Li produced in fragmentation of ^{12}C by protons of 150 and 600 MeV and α particles of 880 MeV were measured by mass spectrometry. The proton-induced cross sections are significantly larger than previous measurements at 600 MeV. The α-induced cross sections are roughly a factor of 2 larger than the proton results. The implications of the new cross sections to the problem of light-element (Li, Be, B) production in cosmic rays are discussed. (auth)

51989 MODEL DEPENDENCE OF PION–NUCLEUS TOTAL CROSS SECTIONS. Silbar, Richard R.; Sternheim, Morton M. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 6: No. 3, 764-9(Sep 1972).

It is shown that pion–nucleus total cross sections are sensitive to the assumed off-shell behavior of the pion–nucleon amplitude. Dependence on energy and nucleon number is discussed, as is an energy-dependent effective nuclear radius arising from the p-wave pion–nucleon interaction. (auth)

51990 POLARIZATION IN THE $D(d,n)^{3}He$ REACTION AND IN $^{12}C(n,n)^{12}C$ ELASTIC SCATTERING. Bucher, W. P.; Beverly, W. B. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Phys. Rev., C; 6: No. 3, 1106-8(Sep 1972).

Previous measurements of the asymmetry in the elastic scattering by ^{12}C of partially polarized 2- to 4-MeV neutrons from the $D(d,n)^{3}He$ reaction are compared with recent data of others for the polarization in the reactions $^{12}C(n,n)^{12}C$ and $D(d,n)^{3}He$. The consistency of various sets of data which are linked by the above measurement is discussed. (auth)

51991 MODELS FOR π^+–^{16}O SCATTERING AT 270 MeV. Koch, Justus H.; Sternheim, Morton M. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 6: No. 3, 1118-19(Sep 1972).

Predictions of the Kisslinger and "local" optical models are compared to π^+–^{16}O elastic differential cross sections at 270 MeV lab kinetic energy. With no adjusted parameters, the local potential gives a remarkably good fit to the data. (auth)

51992 EXCITED STATES OF THE ^{6}Li NUCLEUS. Ismatov, E. I. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 58-62(1971). (In Russian).

Characteristics of the excited states of the ^{6}Li nucleus (mean-square radius and quadrupole moment) were calculated from the cluster model. The first excited state was studied in detail. The mathematical form of the cluster wave function of the ^{6}Li nucleus was defined in terms of the wave function of an α cluster, the wave function of a deuteron, the relative motions of the clusters, the spin–isospin function, the radius vector of the nucleons relative to the center of mass, and an antisymmetry operator. (1 figure) (K.S.W.)

51993 NOVEL VARIANT OF THE METHOD OF REDUCING THE DOPPLER BROADENING OF γ LINES. Begzhanov, R. B.; Akilov, F. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 54-7(1971). (In Russian).

Doppler broadening was reduced through the use of inelastic scattering of the spherically symmetrical diverging flux of fast neutrons from a point source (Po–Be) by the nuclei under investigation. This method was tested by measuring the lifetime of the 477-keV level of ^{7}Li and the 4,430-keV level of ^{12}C (metallic Li and graphite, respectively, with the 10^6 neutrons/s source located at the center of the sample). The values obtained, τ (477 keV) $\leq 10^{-13}$ s and τ (4,430 keV) $\leq 5 \times 10^{-15}$ s, are in good agreement with the results of previous work. (K.S.W.)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 51181, 51982, and 52043.

51994 GAMMA-RAY TRANSITIONS IN ^{20}F. Alexander, L. A.; Collins, W. K.; Hichwa, B. P.; (and others) (Univ. of Notre Dame, Ind.). Phys. Rev., C; 6: No. 3, 817-9(Sep 1972).

The γ-ray decay of the levels of ^{20}F at 1824, 1843, and 3176 keV was studied. Results indicate that each of these levels has only one mode of decay. For the 1824-keV level this finding is consistent with the L = 4 transfer reported by Fortune and Crozier. Together with previous angular-correlation results this determines the probable assignments $J^\pi = 5^+$ for the 1824-keV level and J = 4 for the 823-keV level. This and other recent experimental developments are in good agreement with published calculated ^{20}F structure by Halbert, McGrory, Wildenthal, and Pandya. (auth)

51995 SPECTROSCOPY OF ^{21}Al BY MEANS OF THE REACTION $^{24}Mg(p,p_1'\gamma)^{24}Mg$. Duray, J. R.; Hausman, H. J.; Gearhart, N. L.; Sinclair, J. W. D.; Steiner, W. S. (Ohio State Univ., Columbus). Phys. Rev., C; 6: No. 3, 792-800(Sep 1972).

The triple-correlation geometry suggested by Goldfarb and Seyler was employed in determining the spins of excited states in ^{25}Al by means of the reaction $^{24}Mg(p,p_1')^{24}Mg^*$ (1.37 MeV, $J^\pi = 2^+$). Correlations were measured at 35 laboratory energies between E_p = 3.4 and 4.9 MeV. Excitation functions were measured at five angles for $^{24}Mg(p,p_0)$ and (p,p_1') between E_p = 2.5 and 5.9 MeV in 20-keV steps. Nine previously unreported resonances are observed, corresponding to excitation energies in ^{25}Al (energy in MeV, tentative J^π in parentheses): 5.13, 5.58 ($\geq 5/2$), 5.76 ($1/2^+$), 6.41 ($3/2^-$), 6.53 ($\geq 5/2$), 6.78, 7.02, 7.42, and 7.58. (auth)

51996 DECAY OF ^{35}P. Apt, K. E.; Knight, J. D. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 6: No. 3, 842-6 (Sep 1972).

The β decay of ^{35}P to levels of ^{35}S was studied with a large-volume Ge(Li) detector and a gas-flow proportional counter. The ^{35}P was produced via the $^{37}Cl(t,\alpha p)^{35}P$ reaction by bombardment of NaCl and LiCl targets with 16-MeV tritons, and was chemically separated by conversion to phosphate ion and adsorption on a selective polyvalent anion exchanger. The half-life was measured to be 47.4 ± 0.8 s. Only one γ transition was observed, at 1572.2 ± 0.4 keV. The ^{35}P decays 99^{+1}_{-9}% (log ft = 4.1 ± 0.1) to the 1572-keV $1/2^+$ first excited level of ^{35}S and <9% (log ft > 6.1) to the $3/2^+$ ground state, whence its spin–parity is deduced to be $1/2^+$. Less than 0.45% of the β transitions proceed to any of the other known ^{35}S levels. The results are compared with the predictions of a recent shell-model treatment. (auth)

51997 RESONANCE FLUORESENCE OF ^{23}Na ABOVE 3 MeV. Friesel, D. L.; Lewis, T. J.; Miller, W. C. (Univ. of Notre Dame, Ind.). Phys. Rev., C; 6: No. 3, 846-50(Sep 1972).

Five levels in ^{23}Na were studied using nuclear resonance fluorescence. A previously reported level at 3.91 MeV was identified as a doublet with levels at 3914.0 ± 1.8 and 3916.3 ± 1.8 keV. Levels of 5375.8 ± 2.7, 5742.7 ± 2.9, and 5768.3 ± 2.9 keV have widths (gΓ) of $2.45^{+0.48}_{-0.41}$, $1.29^{+0.10}_{-0.09}$, and $0.62^{+0.05}_{-0.04}$ eV, respectively, as measured by self-absorption experiments. The γ-ray branching ratios for these levels were measured with a 40-cm^3 Ge(Li) spectrometer. (auth)

51998 GENERATOR-COORDINATE SPECTRUM OF ^{20}Ne. Khadkikar, S. B.; Kulkarni, D. R. (Physical Research Lab., Ahmedabad, India). Phys. Rev., C; 6: No. 3, 866-8(Sep 1972).

The generator-coordinate method based on projection from constrained Hartree–Fock states is applied to obtain the T = 0 energy levels of ^{20}Ne. The results obtained with the strength of the external quadrupole field as a generator coordinate compare very well with those of exact shell-model calculations. (auth)

51999 DECAY OF ^{36}K. Miller, D. W. (North Carolina State Univ., Raleigh. Triangle Universities Nuclear Lab., Durham, N. C.); Everling, F.; Outlaw, D. A.; (and others). Phys. Rev., C; 6: No. 3, 869-73(Sep 1972).

The excitation function for the positron decay following the ^{36}Ar(p,n)^{36}K reaction was measured from 15 to 30 MeV by using chopped proton beams from the Triangle Universities Nuclear Laboratory Cyclo-Graaff accelerator. These data were also used to measure the ^{36}K half-life, giving a value of 341 ± 6 ms. Examination of the data at proton energies above the predicted ^{36}Ar(p,2n)^{35}K reaction threshold revealed no positron activity which could be attributed to the decay of the as yet unobserved nuclide ^{35}K. An 80-cm^3 Ge(Li) detector was used to study γ transitions in ^{36}Ar arising from the decay of ^{36}K. The relative intensities of nine γ rays with energies of 1969.8 ± 0.5, 2171.5 ± 0.9, 2208.3 ± 0.4, 2433.7 ± 0.4, 2472.0 ± 0.8, 4180.4 ± 1.0, 4441.7 ± 0.6, 4643.7 ± 1.4, and 6612.7 ± 0.8 keV were used to deduce positron branching ratios of 46, 11, and 43% to ^{36}Ar levels located at 1969.9 ± 0.5, 4442.0 ± 0.5, and 6613.3 ± 0.6 keV, respectively. (auth)

52000 γ–γ ANGULAR CORRELATION AND TIME-INTEGRAL PERTURBED-ANGULAR-CORRELATION MEASUREMENTS ON ^{28}Al. Heiman, Neil; Kossler, W. J. (Coll. of William and Mary, Williamsburg, Va.). Phys. Rev., C; No. 3, 878-84(Sep 1972).

γ–γ angular correlation and time-integral perturbed-angular-correlation measurements involving low-lying levels of ^{28}Al were performed. The 1343–30-keV, 943–30-keV, and 400–943-keV γ–γ angular correlations were studied simultaneously. The results conclusively establish the spin and parity assignments for the ground, 30-, 973-, and 1373-keV states to be 3^+, 2^+, 0^+, and 1^+, respectively. Analysis of the data indicates that the mixing amplitude for the $2^+ \rightarrow 3^+$ transition is δ(E2/M1) = −0.004 ± 0.006, and for the $1^+ \rightarrow 2^+$ transition, δ(E2/M1) = +0.35 ± 0.10. The moment of the 2^+ state was determined by time-integral perturbed angular correlations to be $(+4.27 \pm 0.40)\mu_N$. The implications of this value for the systematics of magnetic moments in the vicinity of A = 28 are discussed, particularly in relation to the theory of weak magnetism in β decay. (auth)

52001 LEVEL STRUCTURE OF ^{22}Ne BY THE ^{21}Ne(d,p)^{22}Ne REACTION. Neogy, P.; Middleton, R.; Scholz, W. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 6: No. 3, 885-93 (Sep 1972).

The ^{21}Ne(d,p)^{22}Ne reaction was studied at a 12 MeV incident energy. Angular distributions of protons were extracted for 31 transitions leading to levels in ^{22}Ne up to 9.10 MeV excitation energy. Angular momentum transfers were identified and spectroscopic factors, extracted for 27 levels by comparison with distorted-wave Born-approximation predictions. Experimental spectroscopic factors for the low-lying states were compared with the predictions of the unified rotational model. The results of the present study indicate that the ground-state rotational band of ^{22}Ne is formed by placing an additional neutron in Nilsson orbit No. 7 ($\frac{3}{2}^+$[211]). Several states were identified which belong to $K^\pi = 1^+$ and 4^+ bands formed by stripping a neutron to Nilsson orbit No. 5 ($\frac{5}{2}^+$[202]) and to $K^\pi = 1^+$ and 2^+ bands formed by stripping to orbit No. 9 ($\frac{1}{2}^+$[211]). (auth)

52002 ROTATIONAL BANDS IN ^{22}Ne EXCITED BY THE ^{18}O(^{7}Li,t)^{22}Ne REACTION. Scholz, W.; Neogy, P.; Bethge, K.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 6: No. 3, 893-900(Sep 1972).

The ^{18}O(^{7}Li,t)^{22}Ne reaction was studied at 12 MeV incident energy. Angular distributions were extracted for 22 triton groups leading to states in ^{22}Ne up to 8.59 MeV in excitation energy. The experimental angular distributions were compared with the predictions of the Coulomb-distorted plane-wave model. L values were assigned and relative α-cluster widths were extracted for the strong transitions. Significant α clustering was observed for 10 states in ^{22}Ne between 6.24 and 8.59 MeV excitation energy. Spin and parity assignments were made to these states from the combined results of the ^{18}O(^{7}Li,t)^{22}Ne and ^{21}Ne(d,p)^{22}Ne reaction. The classification of the α-cluster states into rotational bands was discussed within the framework of the SU(3) model. (auth)

52003 STUDY OF THE ^{24}Mg(^{3}He,p)^{26}Al REACTION. Betts, R. R. (Univ. of Pennsylvania, Philadelphia); Fortune, H. T.; Pullen, D. J. Phys. Rev., C; 6: No. 3, 957-70(Sep 1972).

The nuclear structure of ^{26}Al was studied by means of the ^{24}Mg(^{3}He,p) reaction at an incident energy of 18 MeV. Sixty-five levels below 7 MeV in excitation were observed with an energy resolution of 18 keV. Systematics of the angular-distribution shapes allow several assignments of the angular-momentum transfer, some new spin assignments thereby resulting. Distorted-wave calculations were performed for those states previously thought to be well described in terms of pure two-particle Nilsson configurations relative to a ^{24}Mg core. (auth)

52004 MASS AND DECAY OF A HIGHLY NEUTRON-RICH ISOTOPE OF PHOSPHORUS: 48-SEC ^{35}P. Goosman, D. R.; Alburger, D. E. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., C; 6: No. 3, 820-4(Sep 1972).

^{35}P was produced via the ^{18}O + ^{19}F → ^{35}P + 2p reaction by using 42- to 46-MeV ^{19}F ions, and by the ^{36}S(t,α)^{35}P reaction by using 3.4-MeV tritons. Identification was made from the observed β-delayed γ ray of 1572.41 ± 0.25 keV. By means of the ^{34}S(d,pγ)^{35}S reaction, the γ ray from the first excited state of ^{35}S was measured as 1572.24 ± 0.15 keV, in disagreement with previous measurements. The average of the half-lives for ^{35}P as measured by the first two reactions is 48.1 ± 1.4 s. Upper limits were obtained for β-ray transitions to other excited states in ^{35}S. No information was obtained on a possible β transition to the ^{35}S ground state. The β-ray spectrum measured in coincidence with the 1572-keV γ ray has an end point of 2337 ± 75 keV; this value establishes a mass excess of −24936 ± 75 keV for ^{35}P. These results are consistent with the expected mass and spin–parity ($\frac{1}{2}^+$) of the ^{35}P ground state. Comparison of these results with shell-model calculations is presented. (auth)

52005 MASS OF ^{33}Si, AN EXAMPLE OF EXOTIC NUCLEUS PRODUCTION IN THE s–d SHELL VIA COMPOUND REACTIONS. Goosman, D. R.; Alburger, D. E. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., C; 6: No. 3, 825-8(Sep 1972).

The mass of ^{33}Si was determined by forming this 6.3-s activity in the ^{18}O(^{18}O,2p+n)^{33}Si reaction with 50-MeV ^{18}O ions and by measuring the spectrum of β rays in coincidence with 1848-keV γ rays. An end-point energy of 3980^{+250}_{-200} keV was found for the coincidence β rays; this establishes the mass excess of ^{33}Si as -20509^{+250}_{-200} keV. This result differs from the previously estimated mass by 560^{+250}_{-200} keV. Log-ft values for the decay of ^{33}Si are presented and compared with shell-model calculations. Several heavy–ion compound reactions which might be used to produce other neutron-rich nuclei in the s–d shell are listed. (auth)

52006 MAGNETIC MULTIPOLE PROPERTIES OF ^{38}Cl AND ^{40}K. Kurath, D.; Lawson, R. D. (Argonne National Lab., Ill.). Phys. Rev., C; 6: No. 3, 901-7(Sep 1972).

The effects of weak particle–hole admixtures on magnetic multipole properties of ^{38}Cl and ^{40}K are investigated and the results are compared with experiment, with particular emphasis on M1 transitions between members of the lower quartet of states in each nucleus. In ^{40}K, the admixtures tend to decrease the differences between theoretical and experimental values except for the magnetic moment; however, the same procedure leads to larger discrepancies with experiment in ^{38}Cl. In addition, in the latter nucleus the abnormally large M1 transition strength from the second 3^- level to the first 4^- state cannot be understood if only weak-configuration mixing is assumed. On the other hand, one can account for the experimentally observed strongly inhibited M3 transition between the 5^- and 2^- states of ^{38}Cl. The prime interest is in exhibiting the effects of the separate particle–hole admixtures in order to isolate the source of the discrepancies. (auth)

52007 RESOLUTION OF A DILEMMA IN ^{20}Ne. Fortune, H. T.; Middleton, R.; Betts, R. R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 29: No. 11, 738-40(11 Sep 1972).

Spectroscopic strengths of 0^+ states observed in the reaction ^{19}F(^{3}He,d)^{20}Ne, together with calculations of α-particle widths, imply that the large α width of the 6.72-MeV state arises from mixing with a state of fp-shell character. A long-standing dilemn is thus resolved. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 51818, 51981, 52006, 52022, 52031, 52032, 52042, 52043, 52053, 52067, and 52069.

52008 SPECTRA OF NEUTRONS FROM μ-CAPTURE IN Ca, Tl, Pb, AND Bi. Jahnke, U.; Lindenberger, K. H.; Roeschert, G.; (and others) (CERN, Geneva). Helv. Phys. Acta; 45: 49-51 (1972).

Neutron-gamma angular correlations following μ-capture in Ca, Tl, Pb, and Bi were measured using a coincidence setup. The results are compared with other data. (J.W.R.)

52009 ELASTIC SCATTERING OF NEUTRONS BY K, Co, AND Ce NUCLEI ACCORDING TO THE LOCAL OPTICAL MODEL OF THE NUCLEUS. Kashuba, I. E.; Kostyuk, T. A.; Kotishevskaya, E. Yu. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1735-7(Oct 1971). (In Russian).

Calculations of the differential cross section of elastic scattering of neutrons by ^{39}K, ^{59}Co, and ^{140}Ce were carried out using a local optical model of the nucleus with surface absorption. The dependence of the optimal parameters of the model on the reference points of parametric space is discussed. In the energy dependence of potential parameters for ^{140}Ce there were observed significant fluctuations which could not be explained by reference to non-local interactions. (tr-auth)

52010 SUITABILITY OF THE FESHBACH–LOMON POTENTIAL FOR HARTREE–FOCK CALCULATIONS IN FINITE NUCLEI. Shao, J.; Bassichis, W. H.; Lomon, E. L. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., C; 6: No. 3, 758-63(Sep 1972).

The Hartree–Fock (HF) method was used to calculate certain properties of light, spherical nuclei with the Feshbach–Lomon potential as the two-body interaction. It was found that these many-body calculations are extremely sensitive to certain parameters in the interaction, which are left arbitrary by the fit to two-body scattering data. A set of values for these parameters was determined such that the results of the HF calculation for ^{16}O were reasonable. The binding energies and rms radii of ^{4}He, ^{40}Ca, and ^{48}Ca were then calculated and found to compare favorably with similar results using different interactions. A second-order calculation in a rather severely truncated space indicated that perturbation corrections are larger than those obtained with the Tabakin potential. (auth)

52011 ELECTROMAGNETIC TRANSITIONS IN $(1f_{7/2})^3$ NUCLEI: LIFETIMES OF THE LOW-LYING STATES OF ^{43}Ca. Bini, M. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence); Bizzeti, P. G.; Bizzeti Sona, A. M.; Ricci, R. A. Phys. Rev., C; 6 No. 3, 784-91(Sep 1972).

The mean lives of the three lower levels in ^{43}Ca were measured with a new version of the Doppler-shift-attenuation method, by using a gas as target and absorber. The reaction was ^{40}Ar(α,n)-^{43}Ca at energies ranging from 5.5 to 8 MeV. The results for the mean lives are the following: $\tau_m = 50 \pm 4$, 116 ± 5, and 66 ± 4 ps for the 372-, 593-, and 990-keV levels, respectively. In addition, the relative intensity of γ rays from the decay of the ^{43}Ca levels were obtained at $E_\alpha = 8$ MeV. Electron-conversion measurements were also carried out for the transitions $372 \rightarrow 0$ and $593 \rightarrow 372$ keV, which turn out to be almost pure M1. (auth)

52012 SPIN OF THE 3120-keV LEVEL IN ^{56}Fe. Rogers, V. C. (Brigham Young Univ., Provo, Utah). Phys. Rev., C; 6: No. 3, 801-5(Sep 1972).

The neutron inelastic scattering excitation function of the 3120-keV level in ^{56}Fe was determined from γ-ray production cross-section measurements. The best agreement between experiment and theory was obtained with a 0^+ spin and parity assignment for this level. (auth)

52013 BACKWARD-ANGLE ELASTIC SCATTERING OF ^{16}O on ^{40}Ca AND ^{48}Ca. Groeneveld, K. O.; Meyer-Schuetzmeister, L.; Richter, A.; Strohbusch, U. (Argonne National Lab., Ill.). Phys. Rev., C; 6: No. 3, 805-10(Sep 1972).

Angular distributions at 40 MeV and backward-angle excitation functions in the energy range 25 to 45 MeV were measured for ^{16}O elastic scattering by ^{40}Ca and ^{48}Ca. The ^{16}O + ^{40}Ca excitation function measured in this experiment shows no indication of the marked structure observed in earlier experiments and predicted by angular-momentum-dependent optical-model calculations. The experimental data are discussed by means of both the standard and the L-dependent optical models. (auth)

52014 OCTUPOLE EXCITATIONS IN ^{50}Cr. Peterson, R. J.; Stoub, E. W.; Ristinen, R. A. (Univ, of Colorado, Boulder). Phys. Rev., C; 6: No. 3, 829-35(Sep 1972).

Evidence for the presence of twelve 3^- states in ^{50}Cr is presented from the angular distributions observed for the inelastic scattering of protons, deuterons, ^{3}He, and ^{4}He. The nuclear transition rates are found not to depend upon the spin or isospin of the projectile, but rather upon whether or not it is strongly absorbed by the target nucleus. (auth)

52015 ASYMMETRIES IN GAMMA SCATTERING BY ^{57}Fe. Lee, L. Y.; Goodman, Clark D. (Univ. of Houston, Tex.). Phys. Rev., C; 6: No. 3, 836-41(Sep 1972).

In 90° scattering of 14.4-keV γ rays from ^{57}Fe, several percent difference in the intensities of the conjugate lines in the six-line hyperfine spectrum was observed depending on the vectorial relations between the wave vectors for the incident γ ray, $\vec{k}_i$, the outgoing wave vectors, $\vec{k}_i$, and the magnetic induction field, $\vec{B}$. The hyperfine spectrum were observed depending on the vectorial relations between the wave vectors for the incident γ ray, $\vec{k}_i$, the outgoing wave vectors, $\vec{k}_f$, and the magnetic induction field, $\vec{B}$. The intensity of the line corresponding to the $m = \frac{1}{2} \rightarrow \frac{3}{2} \rightarrow \frac{1}{2}$ transition differs from that of the conjugate transition $m = -\frac{1}{2} \rightarrow -\frac{3}{2} \rightarrow -\frac{1}{2}$, by $+6.8 \pm 2.4\%$. Intensity differences are also found between the $m = \frac{1}{2} \rightarrow -\frac{1}{2} \rightarrow (\frac{1}{2}, -\frac{1}{2})$ line and its conjugate transition ($-6.0 \pm 3.5\%$). The sign of these asymmetries depends on whether $\vec{k}_i \times \vec{k}_f$ is parallel or antiparallel to the internal magnetic field $\vec{B}$. It is likely that these asymmetries result from interference between electronic (Rayleigh) scattering and nuclear resonant scattering. The signs and the calculated values for the asymmetries based on theory agree with the observed values. (auth)

52016 NUCLEAR STRUCTURE OF ^{44}Sc. I. THE ^{44}Ca(^{3}He,t)^{44}Sc REACTION. Manthuruthil, J. C.; Prosser, F. W. Jr. (Aerospace Research Labs., Wright Patterson AFB, Ohio). Phys. Rev., C; 6: No. 3, 851-62(Sep 1972).

The ^{44}Ca(^{3}He,t)^{44}Sc reaction was studied, at an incident energy of $E_{^3\mathrm{He}^{++}} = 25$ MeV, with a magnetic spectrograph. A total of 52 levels in ^{44}Sc were identified below an excitation energy of 3.35 MeV. Ten of the observed levels have not been previously reported. Angular distributions were measured for most of the levels, and analyzed by means of the distorted-wave Born approximation. Definite L-transfer values and spin assignments were made to many levels. As a result, eight states predicted by a recent $(fp)^4$ calculation were identified. In addition, four of the states predicted by a calculation with a single $d_{3/2}$ hole were tentatively identified. The isobaric analog of the ^{44}Ca ground state was located at an excitation energy of 2781 ± 5 keV, in good agreement with previous results. (auth)

52017 NUCLEAR LIFETIMES OF THE 2815- AND 3598-keV LEVELS OF ^{39}K. Bond, P. D.; Kern, B. D. (Stanford Univ., Calif.). Phys. Rev., C; 6: No. 3, 873-7(Sep 1972).

The recoil-distance–Doppler-shift method was used to measure the lifetimes of the 2815- and 3598-keV levels of ^{39}K. These excited states were populated by the reaction ^{6}Li(^{35}Cl,d)^{39}K at 68 MeV. The energies of the γ rays from these two levels were determined with a 55-cm^3 Ge(Li) detector to be 783(±1), 2815(±1), and 3598(±1) keV. The mean lifetime of the 2815-keV level was measured as 79(±8) ps; and that of the 3598-keV level, as 59(±4) ps. The corresponding E3 strengths of 6.0(±0.1) and 25.5(±1.5) Weisskopf units are in very good agreement with the phonon-hole model calculations of Goode and Zambick. (auth)

52018 ENERGY DEPENDENCE OF PROTON INELASTIC SCATTERING FROM ^{40}Ca. Gruhn, C. R.; Kuo, T. Y. T.; Maggiore, C. J.; (and others) (Michigan State Univ., East Lansing). Phys. Rev., C; 6: No. 3, 915-44(Sep 1972).

Inelastic proton scattering from ^{40}Ca was measured at beam energies of 24.93, 30.04, 34.78, and 39.83 MeV. Angular distributions from 13 to 97° for about 40 inelastic states were obtained. Analyses with both microscopic and macroscopic theories are presented. (auth)

52019 PROTON INELASTIC SCATTERING FROM ^{48}Ca. Gruhn, C. R.; Kuo, T. Y. T.; Maggiore, C. J.; Preedom, B. M. (Michigan State Univ., East Lansing). Phys. Rev., C; 6: No. 3, 944-56(Sep 1972).

Inelastic proton scattering from ^{48}Ca was measured at beam energies 25, 30, 35, and 40 MeV. Angular distributions from 13 to 97° for 22 inelastic states were obtained. Analyses with the collective distorted-wave Born approximation are presented. A direct comparison of the excitation of the ^{48}Ca 3.830-MeV 2^+ and 6.342-MeV 4^+ states is made with the low-lying excited 2^+ and 4^+ states of ^{50}Ti and ^{52}Co. (auth)

52020 GAMMA-RAY TRANSITIONS IN ^{56}Ni INDUCED BY THE ^{54}Fe(^{3}He,n)^{56}Ni REACTION. Schneider, P.; Nagel, A.; Bodenmiller, K. H.; Buhl, S. (Univ., Heidelberg). Z. Phys.; 253: No. 4, 309-13(1972).

Ten gamma-ray transitions were observed in the ^{54}Fe(^{3}He,nγ) ^{56}Ni reaction. A new level at 3925 ± 10 keV is established in ^{56}Ni. Spin–parity assignments of 0^+, 4^+, and 2^+ are proposed for the levels at 3.925, 3.958, and 5.352 MeV, respectively. Branching ratios are given. (2 figures) (auth)

52021 STATIC ELECTRIC QUADRUPOLE MOMENTS OF THE FIRST EXCITED STATES OF ^{56}Fe AND THE EVEN TITANIUM NUCLEI. Lesser, P. M. S.; Cline, D.; Goode, Philip; Horoshko, R. N. (Univ. of Rochester, N. Y.). Nucl. Phys.; A190: No. 3, 597-634(1972).

The reorientation effect in Coulomb excitation was used to measure the static electric quadrupole moments of the first excited (2^+) states in ^{48}Ti and ^{56}Fe. These measurements yielded the following values: Q_{2+} (^{48}Ti) = -13.5 ± 8.8 e · fm^2 and Q_{2+} (^{56}Fe) = -24.9 ± 5.8 e · fm^2. Comparison with other measurements indicates that nuclear interaction effects produce spurious quadrupole moments if the distance of closest approach for 180° scattering is much less than 1.25 $(A_p^{1/3} + A_T^{1/3})$ + 6.0 fm. In the present measurements, the 2^+ states were excited by means of ^{32}S projectiles, and the de-excitation γ rays were observed in coincidence with scattered particles by using a multiple detector system. The angular distribution of de-excitation γ rays was found to be significantly attenuated (deorientation effect), and it was crucial to include this effect in analyzing the reorientation data. Measurements of the attenuation were consistent with a magnetic-dipole hyperfine interaction between the excited nuclear state and a randomly fluctuating atomic environment for ions recoiling into vacuum. The effective magnetic hyperfine field was observed to have a velocity dependence consistent with the form $H \propto \beta^x$, where β = recoil velocity/c and x = 0.66 ± 0.13. The static quadrupole moments and other E2 properties of ^{56}Fe are characteristic of a relatively stiff prolate rotor, while ^{46,48}Ti exhibit properties of nuclei soft to collective quadrupole motion. Pure $(f_{7/2})^n$ shell-model calculations for the even titanium isotopes cannot explain the E2 properties of the low-lying levels, and predict static quadrupole moments of the wrong sign. The inclusion of configurations with one nucleon excited into the upper (1f–2p) shell yields a dramatic improvement, compared with the pure $(f_{7/2})^n$ shell-model results, in explaining the experimental E2 properties of ^{48}Ti. A similar, though not so striking, improvement holds for ^{46}Ti. The E2 properties of the ground-state band in ^{56}Fe are adequately described by a 2p–2h shell-model configuration, an inert ^{56}Ni core being assumed. However, the calculation fails to reproduce the magnetic moment of the first excited state, as well as the electromagnetic properties of other low-lying levels, this failure indicates the presence of appreciable admixtures of core-excited configurations in ^{56}Fe. (14 figures, 11 tables) (auth)

52022 SPIN-DEPENDENT REACTION MECHANISM IN ^{46}Ti(d,p)^{47}Ti FROM PROTON-γ CORRELATION. Fitzgerald, T. J.; Moore, W. H. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A190: No. 3, 655-660(1972).

The γ decays of the states in ^{47}Ti at 157 keV and 1547 keV were studied following the ^{46}Ti(d,p)^{47}Ti reaction at 5.0 MeV incident energy. Protons were detected at 0° with a semiconductor detector. The angular correlations of the γ rays with the reaction protons were measured. The E2/M1 mixing ratios of the γ decays and the population ratios of the $m = 3/2$ to the $m = 1/2$ substates were deduced. From the nonzero population of the $m = 3/2$ substate it was concluded that a spin-flip mechanism exists in the ^{46}Ti(d,p) ^{47}Ti stripping reaction. (1 figure, 1 table) (auth)

52023 ^{50}Cr(d,p)^{51}Cr REACTION AND $l_n = 1$ J-DEPENDENCE IN THE (d,p) REACTION. Macgregor, A. E.; Brown, G. (Univ. of Bradford, Eng.). Nucl. Phys.; A190: No. 3, 548-64(1972).

The ^{50}Cr(d,p)^{51}Cr reaction was studied at an incident energy of 10 MeV. Spin assignments were made on the basis of empirical rules for the J dependence of the angular distributions for $l_n = 1$ and $l_n = 3$ transitions. Zero-range DWBA calculations were used to extract spectroscopic factors. (7 figures, 5 tables) (auth)

52024 STUDY OF THE $^{46\ 48}$Ti(^{3}He,t) AND $^{58\ 60}$Ni(^{3}He,t) REACTIONS TO ISOBARIC ANALOGUE STATES. Becchetti, F. D. (Univ. of Copenhagen); Makofske, W.; Greenlees, G. W. Nucl. Phys.; A190: No. 3, 437-70(1972).

The (^{3}He,t) reaction populating 0^+ and 2^+ states in ^{58,60}Cu and ^{46,48}V which are isobaric analog states (IAS) of the 0^+ ground states and 2^+ first excited states in ^{58,60}Ni and ^{46,48}Ti were studied at an incident ^{3}He energy of 24.6 MeV. Triton spectra were measured for the targets ^{46,48}Ti, ^{nat}Ni, and ^{58}Ni, and angular distributions for the 0^+ and 2^+ IAS of ^{46,48}Ti and ^{58,60}Ni were determined. The data were obtained using a magnetic spectrometer and position-sensitive detectors. The results were analyzed using DWBA theory. The $0^+ \rightarrow 0^+$ transitions to analog states are described quite well by using a microscopic form factor derived from a nucleon–nucleon interaction. However, with a Gaussian form, the m.s. radius of this interaction is only limited to the region 0 to 9 fm^2. Comparisons with data at other incident energies indicate that the strength of the effective interaction is strongly energy dependent. The Coulomb energies and (^{3}He,t) angular distributions of the states assigned as the 2^+ analogs in ^{48}V and ^{58,60}Cu are not described well by the models investigated. The ^{46}V 2^+ IAS angular distribution is reproduced by a microscopic calculation, however. The ratios of the $0^+ \rightarrow 2^+$ IAS to the $0^+ \rightarrow 0^+$ IAS transitions are used to deduce a quadrupole deformation for the valence neutrons. The difference in the quadrupole deformations of the matter and proton distributions, as determined by other means, is found to be correlated with those of the valence neutrons. Several transitions to nonanalog states are also investigated. (21 figures, 7 tables, 72 references) (auth)

52025 α TRANSFER TO ^{44}Ti BY THE (^{6}Li,d) REACTION. Strohbusch, U. (Argonne National Lab., Ill.); Fink, C. L.; Zeidman, B.; (and others). Phys. Rev. Lett.; 29: No. 11, 735-8(11 Sep 1972).

The reaction ^{40}Ca(^{6}Li,d) was studied at E(^{6}Li) = 32 MeV. Clearly structured angular distributions, with maximum cross sections of the same order of magnitude as those reported for the reaction ^{40}Ca(^{16}O,^{12}C), were obtained. They are well described by α-transfer distorted-wave Born-approximation calculations. (auth)

52026 NEW PROTON-RICH NUCLEI IN THE $1f_{7/2}$ SHELL. Proctor, I. D. (Michigan State Univ., East Lansing); Benenson, W.; Dreisbach, J.; (and others). Phys. Rev. Lett.; 29: No. 7, 434-6 (14 Aug 1972).

The masses of ^{43}Ti and of the previously unknown nuclei ^{47}Cr, ^{51}Fe, and ^{55}Ni were measured. These proton-rich members of $1f_{7/2}$-shell mirror pairs are important for extensions of nuclear mass relationships to the Z > N region. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 50661, 51981, 52009, 52024, 52034, 52042, 52043, and 52053.

52027 (ANU-P-551) SPIN DETERMINATION FROM COMPOUND NUCLEAR REACTION YIELDS. Carlson, L. E.; Davidson, W. F.; Zuk, W. M.; Najam, M. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). 1972. 14p. Dep. NTIS (U. S. Sales Only).

The relative population of the 2^+ levels at 243 and 288 keV and the 3^+ levels at 390 and 426 keV in ^{62}Cu via the ^{62}Ni(p,n)^{62}Cu reaction was compared to the theoretical prediction of the Hauser–Feshbach statistical compound nuclear reaction model. Whereas the yields of the 243, 288, and 426 keV levels are in accord with the Hauser–Feshbach calculations the observed yield of the 390 keV, 3^+ level is anomalously low, by a factor of 6 to 7. (auth)

52028 (INR-1401) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN POLAND, MAY 1971–APRIL 1972. Marcinkowski, A. (comp.) (Institute of Nuclear Research, Warsaw (Poland)). 1972. 44p. Dep. NTIS (U. S. Sales Only).

- BARIUM-132—neutron reactions (n,2n) at 14.8 MeV, isomeric cross section for, (E)
- BARIUM-134—neutron reactions (n,2n) at 14.8 MeV, isomeric cross section for, (E)
- BARIUM-135—neutron inelastic scattering at 14.8 MeV, isomeric cross section for, (E)
- BARIUM-136—neutron reactions (n,2n) at 14.8 MeV, isomeric cross section for, (E)
- DYSPROSIUM-160—neutron reactions (n,α) at 14 and 18 MeV, differential cross sections for, (E)
- DYSPROSIUM-162—neutron reactions (n,α) at 14 and 18 MeV, differential cross sections for, (E)
- DYSPROSIUM-164—neutron reactions (n,α) at 14 and 18 MeV, differential cross sections for, (E)
- ERBIUM-166—neutron reactions (n,α) at 14 MeV, calculation of α spectra using direct reaction model, (T)
- ERBIUM-168—neutron reactions (n,α) at 14 MeV, calculation of α spectra using direct reaction model, (T)
- EUROPIUM-153—neutron reactions (n,α) at 14 MeV, calculation of α spectra using direct reaction model, (T)
- RUBIDIUM-85—neutron reactions (n,2n) at 13 to 17 MeV, cross sections for, (E)
- RUBIDIUM-87—neutron reactions (n,2n) at 13 to 17 MeV, cross sections for, (E)
- TIN-117—neutron reactions (n,np) at 13 to 17-MeV, cross sections for, (E) (D.L.C.)

52029 LOW-LYING LEVELS OF ^{67}Ga. Mishchenko, V. M.; Popov, A. I.; Storizhko, V. E. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1742-4(Oct 1971). (In Russian).

The quantum characteristics of ^{67}Ga were evaluated through measurements of the excitation functions, angular distribution of γ rays, and n-γ correlations in the reaction ^{67}Zn(p,nγ)^{67}Ga at $E_p \leq 3.1$ MeV. Measurements of the ratio of intensities of γ lines 166 and 824 keV yielded values which agreed well with those calculated. (K.S.W.)

52030 MULTIPLE-SCATTERING EFFECTS IN MEAN-LIFETIME EXPERIMENTS BY BLOCKING TECHNIQUE. Fuschini, E. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Malaguti, F.; Maroni, C.; (and others). Nuovo Cim.; 10A: No. 2, 177-88(21 Jul 1972).

Problems associated with the extraction of compound-nucleus lifetimes from blocking dips are discussed. This is done with reference to previous measurements of the ^{70}Ge(p,p′)^{70}Ge (1.04 MeV, 2^+) and ^{72}Ge(p,p′)^{72}Ge (0.835 MeV, 2^+) reaction times. Different methods that may be used to quantify the filling-in of a blocking dip in a finite-lifetime case are discussed and compared. The importance of multiple-scattering effects in the various types of analyses are investigated. The results are compared to those of other authors to obtain an estimate of the overall accuracy of the technique. (9 figures, 1 table) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 50204, 50740, 51038, 51176, 51181, 51818, 51981, 51982, 52009, 52028, 52053, and 52082.

52031 (AECL-4147) PHYSICS DIVISION PROGRESS REPORT, OCTOBER 1, 1971–DECEMBER 31, 1971. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb 1972. 88p. (PR-P-92). Dep. NTIS (U. S. Sales Only). AECL $2.00.

BISMUTH-209—energy levels of, lifetimes and branching ratios for, (E)
CADMIUM-112—energy levels of, lifetimes for, (E)
HOLMIUM—spin-wave mode measurements
IONS—implantation in solids of heavy, INLAS calculations of distributions of
IRON-53—isomeric transition in, branching ratios and multipolarities for, (E)
LEAD-209—energy levels of, lifetimes and branching ratios for, (E)
MERCURY-203—beta decay of, comparison of measured internal conversion coefficients for, (E)
MOLYBDENUM—phonon frequency measurements
MOLYBDENUM-94—energy levels of, lifetimes for, (E)
MOLYBDENUM-96—energy levels of, lifetimes for, (E)
MOLYBDENUM-98—energy levels of, lifetimes for, (E)
PALLADIUM-105—energy levels of, lifetimes for, (E)
RHODIUM-103—energy levels of, lifetimes for, (E)
SOLIDS—ion penetration in, INLAS calculations of distributions of heavy
TIN-120—energy levels of, lifetimes for, (E) (D.L.C.)

52032 (USNDC-1) REPORTS TO THE U. S. NUCLEAR DATA COMMITTEE, LOS ALAMOS SCIENTIFIC LABORATORY, 23–25 MAY 1972. Jackson, H. E. (comp.) (Argonne National Lab., Ill.). 1972. 250p. (EANDC(US)-168(U); INDC(USA)-43(U)). Dep. NTIS.

BARIUM—neutron capture at 20 eV to 3 keV by natural, cross sections for, p. 97-100, (E)
BARIUM-130—neutron capture at 20 eV to 3 keV, cross sections for, p. 97-100, (E)
BORON--density profiles in silicon, measuring method using (n,α) reactions
BORON-10—neutron elastic scattering at 2.63 MeV, differential cross sections and polarization from, p. 165, (E/T)
CALCIUM-40—neutron reactions with, resonance parameters for, p. 59-66, (E)
CALCIUM-44—neutron reactions with, resonance parameters for, p. 59-66, (E)
CALIFORNIUM-252—fission of, neutron yield from spontaneous, p. 19, (E)
CALIFORNIUM-253—neutron reactions with, cross sections for thermal, p. 98-101, (E)
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GADOLINIUM-158—neutron reactions with, transmission measurements and resonance parameters for, p. 40-59, (E)
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—neutron capture by, absolute gamma intensities from thermal, p. 18-9, (E)
HELIUM-3—neutron elastic scattering at 7.9 to 23.7 MeV, differential cross sections for, p. 114-116, (E)
IRON—neutron elastic scattering at 60 to 600 keV by natural, differential cross sections for, p. 167-70, (E)
IRON-53—energy levels from chromium-50 (α,nγ) reactions, lifetimes and spin-parity assignments for, p. 207, (E)
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LEAD-206—neutron capture at 2.5 to 600 keV, excitation function for, p. 136-40, (E)
LEAD-207—neutron capture at 2.5 to 600 keV, excitation function for, p. 136-40, (E)
LEAD-208—neutron capture at 2.5 to 600 keV, excitation function for, p. 136-40, (E)
MOLYBDENUM-92—neutron capture by, analysis of resonance spectrum using valence model, p. 27-9, (E)
—neutron capture at 6 to 50 keV, excitation function for, p. 134-5, (E)
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SILICON-29—photon reactions (γ,n) at 1.92 MeV endpoint energy, time-of-flight spectrum from, p. 13-15, (E)
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URANIUM—neutron reactions at 0.1 to 100 keV with depleted, temperature-dependent self-indication and transmission from, p. 182-5, (E)
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  —photofission at 5 to 10 MeV, fission and prompt- and delayed-neutron yields from, p. 87-93, (E)
URANIUM-238—photofission at 5 to 10 MeV, fission and prompt- and delayed-neutron yields from, p. 87-93, (E)
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52033 MEAN FISSION NEUTRON CROSS SECTIONS FOR THE REACTIONS ^{93}Nb(n,α)^{90g}Y, ^{93}Nb(n,α)^{90m}Y, AND ^{93}Nb(n,2n)^{92m}Nb. DeRegge, P.; Dams, R.; Hoste, J. (Univ., Ghent). Radiochim. Acta; 17: No. 2, 69-72(Jul 1972).

The mean fission-neutron cross sections for the ^{93}Nb(n,α)^{90m}Y, ^{93}Nb(n,α)^{90g}Y, and ^{93}Nb(n,2n)^{92m}Nb reactions were determined experimentally from the absolute ^{90m}Y, ^{90g}Y, and ^{92m}Nb activities induced in irradiated niobium pentoxide. For this purpose a separation method for yttrium from niobium using fluoride and oxalate precipitations was developed. Niobium was purified from tantalum by anion exchange and homogeneous precipitation methods. The ^{90m}Y and ^{92m}Nb activities were measured by gamma spectrometry; the ^{90g}Y activity was measured by means of a calibrated Geiger–Müeller tube. The cross sections for the reactions ^{93}Nb(n,α)^{90m}Y and ^{93}Nb(n,α)^{90g}Y were found to be 22.1 ± 0.3 and 58.5 ± 2.2 μbarn, respectively. For the cross section for the reaction ^{93}Nb(n,2n) ^{92m}Nb, a value of 420 ± 7 μbarn was obtained. (1 figure, 5 tables) (auth)

52034 IN-BEAM CONVERSION ELECTRON STUDIES OF $^{72\ 74\ 76\ 78}$Se, $^{78\ 80\ 82\ 84}$Kr, $^{114\ 116\ 118\ 120\ 122\ 124\ 126}$Te, AND $^{130\ 132\ 134\ 136\ 138}$Ce UTILIZING (ALPHA, XN) REACTIONS. Wyckoff, Walter Gerald. Davis, Calif.; Univ. of California (1971). 199p. University Microfilms Order No. 72-17,940.

Thesis.

An on-line conversion electron spectrometer, employing a Si(Li) detector and a short solenoidal lens with positron-inhibiting vanes, was built. This system was used in conjunction with a variable energy cyclotron to produce (α,xn) reactions leading to ^{72,74,76,78}Se, ^{78,80,82,84}Kr, ^{114,116,118,120,122,124,126}Te, and ^{130,132,134,136,138}Ce. Conversion electron spectra were obtained from these nuclei, and the resulting relative electron intensities are compared to previous gamma data to obtain conversion coefficients. These coefficients confirm virtually all of the E2 multipolarities claimed in the gamma work, and therefore add to the evidence of quasi-rotational behavior in these nuclei. (Diss. Abstr. Int., B)

52035 DECOUPLED YRAST STATES IN ODD-MASS NUCLEI. Stephens, F. S. (Univ. of California, Berkeley); Diamond, R. M.; Leigh, J. R.; Kammuri, T.; Nakai, K. Phys. Rev. Lett.; 29: No. 7, 438-41(14 Aug 1972).

A system consisting of a particle coupled to a rotating core is studied. Although a complete decoupling of particle and core occurs only at very small deformations (coupling strengths), a "favored" high-spin band of levels tends to be decoupled over a much larger region of deformation. This can be understood as a simple Coriolis effect, and seems to be borne out remarkably well in some odd-A La isotopes. (auth)

52036 ANOMALOUS TWO-PHONON (p,t) TRANSITIONS IN CADMIUM. Comfort, J. R. (Princeton Univ., N. J.); Braithwaite, W. J.; Duray, J. R.; Yoshida, S. Phys. Rev. Lett.; 29: No. 7, 442-5(14 Aug 1972).

Data were obtained for (p,t) reactions with ^{112,114,116}Cd at E_p= 27.9 MeV. The angular distributions for $J^\pi = 0^+$ and 2^+ two-phonon states differ markedly in phase from zero- and one-phonon transitions. The ratios of cross sections to the 2^+ states are systematically an order of magnitude larger than expected from B(E2) ratios. Two-step mechanisms are suggested. (auth)

52037 PARITY VIOLATION IN NEUTRON-CAPTURE γ RAYS. Alberi, J. L. (Harvard Univ., Cambridge, Mass.); Wilson, Richard; Schroeder, I. G. Phys. Rev. Lett.; 29: No. 8, 518-21(21 Aug 1972).

The circular polarization of γ rays from thermal neutron capture in ^{113}Cd was measured, and a $P_\gamma = (6.0 \pm 1.5) \times 10^{-4}$ was found for the combined 8.51- and 9.04-MeV transitions. This value was measured using a transmission Compton polarimeter and pulse-counting technique. The value confirms the existence of parity-nonconserving terms in the internucleon force. (auth)

52038 STRONG AND WEAK 0^+ EXCITATIONS IN THE ^{142}Ce(p,t)^{140}Ce AND ^{140}Ce(p,t)^{138}Ce REACTIONS. Sherman, J. D. (Univ. of California, Berkeley); Harvey, B. G.; Hendrie, D. L.; Zisman, M. S.; Soerensen, Bent. Phys. Rev., C; 6: No. 3, 1082-7(Sep 1972).

The 0^+ level structure of ^{140}Ce and ^{138}Ce as revealed by the ^{142}Ce(p,t) and ^{140}Ce(p,t) reactions is reported. Comparisons are made to a model which mixes the anharmonic pair vibration with "two multipole-phonon" 0^+ excitations and "one-phonon" 0^+ proton configurations. The 5.57-MeV 0^+ level in ^{140}Ce may be a pair analog to the weak 0^+ level in ^{138}Ce at 2.32 MeV. (auth)

52039 ^{96}Mo(p,xn) REACTION FROM 10 TO 80 MeV. Hogan, James J. (McGill Univ., Montreal). Phys. Rev., C; 6: No. 3, 810-16(Sep 1972).

Excitation functions for the ^{96}Mo(p,xn)$^{97-x}$Tc reactions were measured for proton bombarding energies from 10 to 80 MeV. These experimental results are compared to excitation functions calculated using the most recent version of intranuclear cascade model, that known as VPOT, as well as the older STEP. The two models are compared, particularly with reference to improvements in the newer, more sophisticated VPOT. This model provides substantially better agreement with experiment than STEP, although it is also found to introduce new problems. (auth)

52040 REORIENTATION EFFECT MEASUREMENTS ON $^{134\ 136\ 138}$Ba. Kerns, J. R.; Saladin, J. X. (Univ. of Pittsburgh). Phys. Rev., C; 6: No. 3, 1016-23(Sep 1972).

The angular distribution of the ratio of scattered ions exciting the first 2^+ state to elastically scattered ions was measured by using the ^{16}O beam from the University of Pittsburgh tandem Van de Graaff accelerator. Values of the reduced transition probability $B(E2, 0^+ \rightarrow 2^+)$ and the static quadrupole moment Q_{2+} of the first 2^+ state were determined. The $B(E2, 0^+ \rightarrow 2^+)$ values obtained are 0.672 ± 0.016, 0.418 ± 0.011, and 0.221 ± 0.009 e^2b^2 for Ba^{134,136,138}, respectively. The spectroscopic quadrupole moments of the first 2^+ state of these nuclei are found to be −0.64 ± 0.14, −0.19 ± 0.17, and −0.07 ± 0.15 e b, respectively. The results are compared with the predictions of various models. (auth)

52041 SPINS OF LEVELS IN ^{148}Sm. Gelletly, W. (Univ. of Manchester, Eng. Brookhaven National Lab., Upton, N. Y.); Kane, W. R. Phys. Rev., C; 6: No. 3, 1113-17(Sep 1972).

The primary neutron-capture γ rays emitted in the decay of the 3.4-eV resonance in ^{147}Sm were studied with a Ge(Li) detector and the crystal diffraction neutron monochromator at the Brookhaven high-flux beam reactor. The results obtained complement previous average resonance capture studies. The spins and parities of levels at 1453.6 and 1663.4 keV are shown to be 2+. The results also indicate previously unreported levels at (1648.6), 1970.9, and 2142.5 keV with spins 2, 3, or 4. The spin of the 3.4-eV resonance is confirmed to be 3−. (auth)

52042 EXCITATION FUNCTION OF (p,pn) REACTIONS AT HIGH ENERGY. Das, S. (Univ. of Calcutta); Gupta, B. K.; Bhattacharya, P. C.; Biswas, M. M. Nucl. Phys.; A190: No. 3, 501-13(1972).

A closed theoretical formula was derived for the (p,pn) reaction cross section at high energies in light, medium, and heavy nuclei, and a comparison of the calculated cross sections with the experimental data was made for ^{12}C, ^{19}F, ^{54}Fe, ^{58}Ni, ^{59}Co, ^{64}Zn, ^{65}Cu, ^{100}Mo, ^{127}I, ^{142}Ce, ^{182}Ta, and ^{238}U at incident energies above 50 MeV. Good agreement between experimental and calculated cross sections was obtained in the entire energy range considered. In deducing the formula a direct reaction with a pure knock-out mechanism was assumed. (7 figures, 9 tables) (auth)

52043 (n,p) CROSS SECTIONS FOR 14 MeV NEUTRONS. Eder, G. (Oesterreichische Hochschule, Vienna); Winkler, G.; Hille, P. Z. Phys.; 253: No. 4, 335-49(1972).

By using both older compilations and recent data, the (n,p) cross sections for neutron energies between 14 and 15 MeV were collected and critically revised. The experimental data can be represented phenomenologically by the formula $\log_{10}(\sigma_{np}/\text{mb}) = 0.2 + 0.4A^{1/3} - 4.6(N-Z)/A^{2/3}$. The compound part of the (n,p) reactions is described by a statistical model; the direct reactions are taken into account semiempirically. (4 figures, 2 tables) (auth)

52044 NUCLEAR DATA SHEETS FOR A = 125. Auble, R. L. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 7: No. 5, 465-510(May 1972).

The Nuclear Data Sheets for A = 125, last compiled in 1960, were updated; and adopted decay schemes, level properties, and gamma-ray properties are presented. The present compilation includes all pertinent nuclear structure data available through February 1972. The data from a later reference on ^{125}Te were added in proof but are not used in obtaining the adopted values. The information is presented in the form of level schemes showing essentially all of the adopted level and decay properties, followed by the compiled data (data sheets) and adopted values (summary sheets) for each nucleus in the A-chain. For those nuclei on which there are very few data (^{125}Cd, ^{125}In, ^{125}Cs, ^{125}Ba, ^{125}La), all information is given on the summary sheet only. (auth)

52045 NUCLEAR DATA SHEETS FOR A = 122. Bertrand, F. E. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. B; 7: No. 5, 419-63(May 1972).

The 1960 version of the Nuclear Data Sheets for A = 122 was revised on the basis of data received before April 1972. All literature containing nuclear structure data pertaining to A = 122 was reviewed and evaluated, over 125 references being used. The compilers noted inconsistencies or lack of data by the use of footnotes throughout the compilation. Ten nuclei are proposed as members of the A = 122 mass chain including the tentative assignments ^{122}Ag, ^{122}Cd, and ^{122}Ba. Only for the nuclei of Sn, Sb, Te, I, and Xe have excited levels been established; however, more than one state is proposed for In and Cs with uncertainty as to which state is the ground state. Recent data on resonance and thermal-neutron capture in ^{122}Sb have led to the complicated level and decay scheme shown for ^{122}Sb. Only a few spins are known for these levels, primarily because of a lack of definitive reaction experiments. For the nuclei of Sn and Te, the level energies and J$^{\pi}$-values are based mainly on one or two reaction experiments; for Sn, the (p,p′) reaction; and for Te, (^{3}He,d) and (p,t) reactions. This A-chain compilation is organized in four distinct parts in the following order: drawings, summary sheets for all nuclei, data sheets for nuclei (for some nuclei there are no data sheets, only summary sheets), and references. (auth)

Nuclear Properties and Reactions, $150 \leq A \leq 189$

Refer also to abstracts 51980–51982, 52028, 52043, 52058, and 52082.

52046 STUDY OF THE REACTION ^{176}Lu(n,γ)^{177}Lu BY MEANS OF A PAIR AND ANTI-COMPTON SPECTROMETER. Michaud, B.; Kern, J.; Ribordy, L.; Schaller, L. A. (Univ., Fribourg, Switzerland). Helv. Phys. Acta; 45: 93-131(1972). (In French).

The ^{176}Lu(n,γ) reaction has been studied by means of a pair and anti-Compton spectrometer. The high energy resolution and peak-to-background ratio have allowed observation of new γ-lines and improved the energy accuracy of the known ones. New transitions have been fitted into a more precise level scheme. The neutron separation energy was found to be $E_n = 7072.4 \pm 0.6$ keV. The results are interpreted in terms of the collective model. Inconsistencies about the $\frac{1}{2}^+$ [411] rotational band are discussed and two alternative constructions are given. The $\frac{5}{2}^-$ ground level of the $\frac{1}{2}^-$ [541] band was disclosed at 761.7 keV. A tentative rotational band is built on this state. (auth)

52047 COMPARISON OF MUONIC AND MOESSBAUER ISOMER SHIFTS. Walter, H. K.; Backe, H.; Engfer, R.; (and others). Helv. Phys. Acta; 45: 47-9(1972).

Some new results for isomer shifts in ^{153}Eu are presented. A comparison of muonic and Moessbauer isomer shifts is made. A model analysis is performed using a Fermi distribution with fixed central density. It is shown that isomer shifts are produced by an increase in surface thickness and a decrease in radius. (J.W.R.)

52048 ^{157}Sm, A NEW ISOTOPE. Morcos, N. A.; Adams, D. E.; James, W. D.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Phys. Rev., C; 6: No. 3, 862-5(Sep 1972).

Irradiation of enriched ^{160}Gd with fast neutrons was found to produce a new radioactivity, which was assigned to the (n,α) product, ^{157}Sm. The following radiation characteristics were observed to belong to ^{157}Sm: half-life 83 ± 2 s, γ-ray energy 121.5 ± 0.5 keV, and maximum β^--ray energy 2.83 ± 0.05 MeV. (auth)

52049 GAMMA-RAY INTENSITIES AND BRANCHINGS IN ^{178}Hf FOLLOWING DECAY OF ^{178}Ta (9.3 min). Siddiqi, T. A.; Emery, G. T. (Indiana Univ., Bloomington). Phys. Rev., C; 6: No. 3, 1009-15(Sep 1972).

The relative intensities of γ rays in ^{178}Hf, excited in the decay of 9.3-min ^{178}Ta, were determined with a Ge(Li) spectrometer. It is proposed that the rates for decay of the 1276-keV (2^+, K = 0) state by E2 transitions to the ground-state band are perturbed by an admixture of (K = 2) γ vibration in the initial state. (auth)

52050 SHRINKING OF THE NUCLEAR CHARGE RADIUS IN THE FIRST ROTATIONAL STATE OF ^{178}Hf. Boolchand, P. (Univ. of Cincinnati); Langhammer, David; Lin, Ching-lu; Jha, S.; Peek, Neal F. Phys. Rev., C; 6: No. 3, 1093-8(Sep 1972).

The Moessbauer isomer shift for the 93.2-keV transition in ^{178}Hf was studied in Hf metal, HfO_2, HfC, and cyclopentadinyl hafnium dichloride, $Hf(Cp)_2Cl_2$. One can qualitatively understand the shifts in terms of shielding of s electrons by valence 5d electrons. An unambiguous iosmer shift of +0.19 ± 0.06 mm/s was observed between $Hf(Cp)_2Cl_2$ and Hf metal. This is interpreted as evidence of a shrinking of the nuclear charge radius of ^{178}Hf in the first rotational state. The change in the s electron density between $Hf(Cp)_2Cl_2$ and Hf metal is estimated by correlating it to the observed isomer shifts between $Os(Cp)_2$ and Os metal; it is found that $\delta\langle r^2\rangle(^{178}\mathrm{Hf}) = -0.37 \times 10^{-3}\ \mathrm{fm}^2$, $\delta\langle r^2\rangle/\langle r^2\rangle(^{178}\mathrm{Hf}) = -0.13 \times 10^{-4}$. (auth)

52051 MEASUREMENT OF PARITY ADMIXTURES IN NUCLEAR FORCES IN ^{180}Hf, ^{181}Ta, AND ^{203}Tl. Kuphal, Eckart (Technische Hochschule, Darmstadt, Ger.). Z. Phys.; 253: No. 4, 314-34(1972).

Parity mixing in nuclear states was studied by measuring the circular polarization, P, of the γ radiation emitted from unpolarized nuclei. The analyzer was a "radial transmission magnet" of high symmetry. With 4 NaI scintillation counters and the current integration method, 4 independent results were obtained simultaneously. The polarimeter efficiency was determined via the quadratic Compton effect. Studies of the polarized bremsstrahlung with ^{170}Tm, ^{177}Lu, and ^{198}Au sources served as tests for the calculated corrections due to the bremsstrahlung effect. Results for the circular polarization are $P = -(2.0 \pm 0.4) \cdot 10^{-3}$ for the 501-keV transition in ^{180}Hf, $P = +(1 \pm 4) \cdot 10^{-6}$ for the 482-keV transition in ^{181}Ta, and $P = +(1 \pm 7) \cdot 10^{-6}$ for the 279-keV transition in ^{203}Tl. Thus, in the case of ^{180}Hf, the existence of the parity mixing in nuclear states was confirmed. (auth) (10 figures, 2 tables, 51 references)

52052 DECAY OF ^{170}Lu TO LEVELS IN ^{170}Yb. Camp, David C. (Univ. of California, Livermore); Bernthal, Fred M. Phys. Rev., C; 6: No. 3, 1040-81(Sep 1972).

The locations of 70 energy levels in ^{170}Yb were deduced from Compton-suppressed γ-ray singles, three-crystal γ-ray pair, conversion-electron, and Ge(Li)–Ge(Li) γ–γ coincidence measurements on the electron-capture–β^+ decay of ^{170}Lu. Both chemically separated and isotopically separated sources of ^{170}Lu were used in collecting the data. A total of 550 γ-ray transitions were observed in the ^{170}Lu decay spectrum, 220 of which are definitely assigned to the ^{170}Yb level scheme from 112 coincidence spectra. These definitive transitions account for 93% of the total observed γ-ray intensity. An additional 118 γ-ray transitions were placed on the basis of excited-state energy differences. Eight E0 transitions were observed in the conversion-electron data. Each of four excited 0^+ states identified has less than 1% β decay feeding from the 0^+ parent. Spin and parity assignments are proposed for 46 levels in addition to the ground-state rotational band members. The ^{170}Yb level structure is compared with available theoretical calculations, and a preliminary interpretation of several features of the decay scheme is presented. (auth)

52053 CROSS SECTIONS FOR SEVERAL (n,2n) REACTIONS AT 14 MeV. Nethaway, D. R. (Univ. of California, Livermore). Nucl. Phys.; A190: No. 3, 635-44(1972).

Precision measurements of the cross sections for the (n,2n) reactions to produce ^{44m}Sc, ^{88}Y, ^{89}Zr, ^{92}Nb, ^{150}Eu(35y), ^{168}Tm, $^{174m+g}$Lu, and ^{196}Au were made for a range of neutron energies from 13.7 to 15.0 MeV. The samples were irradiated at various positions on the surface of a 20-cm-radius sphere centered at the d–T neutron source. This allowed a range of neutron energies to be obtained with good energy resolution. The ^{27}Al(n,α)^{24}Na reaction was used to monitor the neutron fluence in the target samples. Particular attention was given to the accurate measurement of the (n,2n) products, using calibrated Ge(Li) and NaI(Tl) detectors. An uncertainty of about ±5% is assigned to the results, except those for ^{150}Eu and ^{174}Lu, which have an additional uncertainty in their decay schemes. (auth)

52054 ISOMERIC E1 TRANSITIONS WITH $\Delta K = 0$ IN ^{171,173}Lu. Andrejtscheff, W.; Dubbers, F.; Manfrass, P.; Schilling, K.-D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A190: No. 3, 489-500(1972).

An experimental arrangement for ns lifetime measurements in nuclear reactions is briefly described. The half-life of the level at 208.1 keV in ^{171}Lu was determined in the reaction

^{169}Tm(α,2n)^{171}Lu as $T_{1/2} = 30 \pm 3$ ns. Delayed and populating γ-ray spectra were measured by applying the method of delayed $\gamma-\gamma$ coincidences. In the radioactive decay of ^{173}Hf, the lifetime of the level at 425.1 keV in ^{173}Lu was measured as $T_{1/2} = 0.68 \pm 0.08$ ns. Comparisons with Weisskopf and Nilsson estimates were performed with pairing correlations taken into account. A modified Nilsson Hamiltonian was used. The dependence of E1 transition probabilities between the states $\frac{1}{2}^{+}$[411] and $\frac{1}{2}^{-}$[541] on the difference of the initial- and final-state deformations was studied. Qualitative agreement with semi-microscopic calculations of equilibrium deformations was found. Lifetimes of the $\frac{3}{2}$ $\frac{1}{2}^{+}$[411] states were estimated. (9 figures, 3 tables) (auth)

52055 TIME DIFFERENTIAL PERTURBED ANGULAR CORRELATION STUDIES WITH ^{154}Gd IN A LIQUID ENVIRONMENT AT DIFFERENT TEMPERATURES. Hammesfahr, A.; Lopez-Garcia, A.; Weigand, U. (Univ., Bonn). Z. Phys.; 253: No. 4, 360-8(1972).

The perturbation of gamma–gamma angular correlations in the 1.17-ns 2^+ state of ^{154}Gd was studied by using ^{154}Eu activity dissolved in 6N $HClO_4$. Time differential measurements were performed at five different temperatures between 0°C and −80°C. The environment remains in the liquid phase in the whole temperature range, and the attenuation of the angular correlations can be described by the theory of Abragam and Pound. The observed attenuation parameters λ_2 and λ_4 were used to derive separately the strengths of the magnetic dipole interaction and the electric quadrupole interaction between the nuclei and their environment. The observed temperature dependence of the magnetic dipole and electric quadrupole interaction strength can be understood by a simple model of the attenuation mechanism. (auth) (4 figures, 1 table)

52056 ROTATIONAL BANDS AND FAST E1 TRANSITIONS IN ^{163}Ho. Funke, L.; Kaun, K. H.; Kemnitz, P.; Sodan, H.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A190: No. 3, 576-96(1972).

The level scheme of the deformed odd-proton nucleus ^{163}Ho was investigated by in-beam and decay spectroscopic methods. Singles γ-ray spectra, conversion electron spectra, $\gamma-\gamma$ coincidences, and angular distributions of the γ rays were measured in the reaction ^{163}Dy(d,2nγ) at a deuteron energy of about 13.5 MeV. Singles γ-ray spectra were also taken in the ^{163}Dy(p,nγ) reaction with 6.7-MeV protons. Additional information on the ^{163}Ho level scheme was obtained by reinvestigating the γ radiation in the electron-capture decay of ^{163}Er. The proposed level scheme of ^{163}Ho contains, in addition to the ground-state band, $\frac{7}{2}^{-}$[523], the rotational bands built on the intrinsic states $\frac{7}{2}^{+}$[404], $\frac{3}{2}^{+}$[411], $\frac{1}{2}^{+}$[411], and $\frac{1}{2}^{-}$[541] (band heads at 439.94, 360.36, 297.88, and 471.25 keV, respectively). Further levels at 1113.5, 876.0, and 614.3 keV are interpreted as being mainly the quasi-particle excitations $\frac{5}{2}^{-}$[532], $\frac{5}{2}^{+}$[413], and possibly the ground state γ vibration, respectively. A comparison of the quasi-particle excitations in the Ho isotopes is performed on the basis of the Nilsson model including pairing corrections. Discontinuities in the rotational bands are described by Coriolis coupling effects. Several fast E1 interband transitions were observed in ^{163}Ho. Some of them connect levels of the $\frac{1}{2}^{+}$[411] band with the ground-state band, $\frac{7}{2}^{-}$[523]. The appearance of these K-forbidden transitions is explained by a weak mixing between states of the bands $\frac{1}{2}^{+}$[411] and $\frac{7}{2}^{+}$[404] caused by Coriolis interaction. (9 figures, 6 tables) (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 51818, 51981, 52008, 52031, 52032, 52043, and 52053.

52057 MAGNETIC MOMENTS OF THE 7^- AND 5^- ($\pi h_{9/2}$, $\nu g_{9/2}$) STATES IN ^{210}Bi. Baba, C. V. K.; Faestermann, T.; Fossan, D. B.; Proetel, D. (Univ., Munich). Phys. Rev. Lett.; 29: No. 8, 496-9(21 Aug 1972).

The g factors of the 433-keV 7^- state and the 439-keV 5^- state in ^{210}Bi, which are predominantly ($\pi h_{9/2}$,$\nu g_{9/2}$), were measured as $g(7^-) = 0.302 \pm 0.007$ and $g(5^-) = 0.306 \pm 0.009$ by a time-differential method by using the reaction ^{208}Pb(^{7}Li,αn)^{210}Bi. From these experimental results, a magnetic moment for the $g_{9/2}$ neutron of $\mu = -(1.33 \pm 0.06)\mu_N$ [$g(\nu g_{9/2}) = -0.296 \pm 0.014$] was deduced. This $g_{9/2}$-neutron magnetic moment is in agreement with the Schmidt value corrected for core polarization. (auth)

52058 FISSION BARRIERS FOR NUCLEI LIGHTER THAN RADIUM. Mosel, Ulrich (Univ. of Washington, Seattle). Phys. Rev., C; 6: No. 3, 971-85(Sep 1972).

Potential energy surfaces were calculated for the mass range $180 \le A \le 212$ by using the shell-correction method on the basis of a symmetric two-center shell model. All calculations were performed both with a constant and with a surface-dependent pairing strength. The results show that the fission barriers calculated with the latter prescription are incompatible with experimental data. The calculations for a constant pairing strength, however, in which the shells at the saddle are calculated on the same basis as those at the ground state, agree reasonably well with experimental data of the Berkeley group. The shell corrections for these nuclei are analyzed separately in detail, and are found to exhibit remarkable regular structures, which can be explained by an interplay between the shells of the fragments and those of the fissioning nucleus. Finally, the existence of shape-isomeric states and the treatment of the zero-point energy in these calculations are discussed. (auth)

52059 ELECTROMAGNETIC PROPERTIES OF EVEN–EVEN PLATINUM NUCLEI. Berkes, I.; Rougny, R.; Meyer-Levy, Michele; (and others) (Univ. Claude Bernard, Lyon). Phys. Rev., C; 6: No. 3, 1098-1105(Sep 1972).

The lifetimes of the first and second excited states in ^{194,196}Pt were determined with delayed coincidence techniques: ^{194}Pt $\tau(2^+) = 50 \pm 5$ ps, $\tau(2^{+\prime}) = 51 \pm 6$ ps, ^{196}Pt $\tau(2^+) = 43.6 \pm 3.0$ ps, $\tau(2^{+\prime}) = 52 \pm 5$ ps. For this latter level the crossover/stopover intensity ratio is $\le 6.10^{-5}$. Deduced B(E2) transition probabilities show a simultaneously diminishing trend for $2^{+\prime} \rightarrow 0^+$ and $2^{+\prime} \rightarrow 2^+$ versus atomic mass number. New lifetimes are used to reevaluate nuclear g factors, which all lie around $g_{2+} \approx 0.3$. Phenomenological anharmonic vibration-model calculations reproduce well the measured quadrupole transition probabilities and nuclear g factors. (auth)

52060 POSSIBILITY OF STRONG MULTIPOLE VIBRATIONS IN THE LOW-EXCITATION REGION OF THE NUCLEAR CONTINUUM. Lewis, M. B.; Bertrand, F. E. (Oak Ridge National Lab., Tenn.). Phys. Rev., C; 6: No. 3, 1108-9(Sep 1972).

Estimates for ^{208}Pb(α,α') cross sections at 65 MeV show strong preference for high angular momentum transfers and, if the maximum allowable collective strength is invoked, yield absolute cross sections comparable to those recently measured in the 10- to 25-MeV excitation region of ^{208}Pb. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 50423, 50426, 52032, 52042, 52082, and 52283.

52061 (LA–4918) EVALUATED NEUTRON-INDUCED GAMMA-RAY PRODUCTION CROSS SECTIONS FOR ^{235}U AND ^{238}U. Stewart, L.; Hunter, R. E. (Los Alamos Scientific Lab., N. Mex.). Jul 1972. Contract W-7405-eng-36. 25p. Dep. NTIS.

The gamma-ray production cross sections produced by neutron interactions from 10^{-5} eV to 20 MeV have been evaluated for ^{235}U and ^{238}U. The data were prepared for input into the ENDF/B format. Below 1 MeV, the "prompt" fission and radiative-capture spectra are included along with the gammas from inelastic scattering. Above 1 MeV, the total gamma-ray production cross sections from all nonelastic processes are input as a single reaction since the experimental measurements did not discriminate between the individual reaction channels. At all energies, all gamma rays are assumed to be emitted isotropically. (auth)

52062 CORRELATION BETWEEN FISSION-CHANNEL EFFECTS AND FRAGMENT KINETIC ENERGIES. Moore, M. S. (Los Alamos Scientific Lab., N. Mex.); Miller, L. G.; Stokes, G. E. Phys. Rev. Lett.; 29: No. 8, 504-5(21 Aug 1972).

A measurement of the relative yield of fission events associated with the highest–kinetic–energy fragments was made for several resonances in ^{235}U. The results show that this yield is strongly correlated with K, the fission-channel quantum number. (auth)

52063 ANGULAR ANISOTROPY OF THE FRAGMENTS FROM FISSION OF ^{232}Th AND ^{238}Pu BY 13.40 TO 14.80 MeV NEUTRONS. Shpak, D. L.; Blokhin, A. I.; Ostapenko, Yu. B.; Smirenkin, G. N. JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 228-9(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 323-5(20 Mar 1972).

A multi-angle detector was used to measure the angular distributions of fragments from the fission of ^{232}Th and ^{230}Pu by 13.40- to 14.80-MeV neutrons. The angular anisotropies of fragments were determined as a function of incident neutron energy. (J.W.R.)

52064 PROMPT GAMMA RAYS EMITTED IN THE THERMAL-NEUTRON-INDUCED FISSION OF ^{235}U. Pleasonton, Frances; Ferguson, Robert L.; Schmitt, H. W. (Oak Ridge National Lab., Tenn.). Phys. Rev., C; 6: No. 3, 1023-39(Sep 1972).

The average number and average energy of γ rays emitted within ~5 ns after fission were determined as functions of fragment mass and as functions of fragment mass and total kinetic energy in two-dimensional representations. In a four-parameter experiment, energies of coincident pairs of fission fragments were measured with surface-barrier detectors and γ-ray energies were measured with a large NaI(Tl) detector, which was located 89 cm from a thin ^{235}U target and positioned coaxially with the fragment detectors. The time difference between detection of a fission fragment and a γ ray was measured to allow time-of-flight discrimination against fission neutrons. The γ-ray data were analyzed with a "weighting method" proposed by Maier–Leibnitz to deduce average numbers and energies of γ rays from measured pulse heights. The Doppler shift in the laboratory angular distribution of γ emission was utilized to obtain the number and energy of γ rays as functions of single fragment mass. The results, for both average number and average energy as functions of single fragment mass, are characterized by a sawtooth behavior similar to that which is well known for neutron emission. The overall average number and energy of γ rays emitted per fission were found to be 6.51 ± 0.3 and 6.43 ± 0.3 MeV, respectively, thus, an average photon energy of 0.99 ± 0.07 MeV was determined. (auth)

52065 EXCITATION FUNCTIONS FOR THE PRODUCTION OF FISSION ISOMERS IN VARIOUS Am ISOTOPES. Britt, H. C.; Erkkila, B. H.; Back, B. B. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 6: No. 3, 1090-2(Sep 1972).

Excitation functions for the population of shape isomers in americium nuclei were studied by triton and proton bombardment of ^{239}Pu, ^{240}Pu, ^{242}Pu, and ^{244}Pu with triton energies ranging from 10 to 16 MeV and proton energies from 9 to 16 MeV. The reactions studied are (t,2n), (t,3n), and (p,2n) leading to final nuclei ^{241,243,245}Am, ^{240,242,244}Am, and ^{238,239,241,243}Am, respectively. In two cases half-lives were obtained, namely, ^{240}Pu(p,2n)^{239m}Am, $T_{1/2}$ = 163 ± 12 ns and ^{244}Pu(t,2n)^{245m}Am, $T_{1/2}$ = 390 ± 70 ns. (auth)

52066 LEVEL STRUCTURES OF THE NUCLEI ^{232}Th AND ^{238}U. McMurray, W. R.; van Heerden, I. J. (Southern Universities Nuclear Inst., Faure, S. Afr.). Z. Phys.; 253: No. 4, 289-97(1972).

Time-of-flight gating techniques were used to study the decay γ rays from states excited by inelastic scattering of neutrons from ^{232}Th and ^{238}U. Neutron energies up to 1900 MeV were used. From accurate determinations of the γ-ray energies, intensities, and thresholds, detailed level and decay schemes were obtained for ^{232}Th and ^{238}U. New levels in both nuclei were observed at larger excitations than before, and the present work is incompatible with some previously accepted spin and collective band assignments derived from Coulomb excitation studies. (auth) (2 figures, 2 tables)

Nuclear Theory

Refer also to abstracts 50655, 51834, 51920, and 52042.

52067 (WCAP-7280) INTERPRETING FAST REACTION CROSS SECTIONS BY STATISTICAL METHODS. Azziz, Nestor; Connelley, James W. (Westinghouse Electric Corp., Pittsburgh, Pa.). Aug 1970. 108p.

The statistical model for nuclear reactions first used by Weisskopf and Ewing is reviewed and extended and used to predict neutron fast reaction cross sections, such as (n,α), (n,p), (n,2n), (n,pn), (n,np), etc. The results show agreement with experimental values. The nuclear parameters for the level density are discussed and modifications are proposed for some of them. Capture cross sections and level densities were predicted and are tabulated for many isotopes. Results and details of the calculations are given for one- and two-particle emission for ^{54}Fe, ^{56}Fe, and ^{59}Co between 2 and 15 MeV. (auth)

52068 DETERMINATION OF NUCLEAR SPECTROSCOPIC FACTORS BY DISPERSION RELATIONS. Kisslinger, Leonard S. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev. Lett.; 29: No. 8, 505-9(21 Aug 1972).

The spectroscopic factors for d → np and ^{4}He → n^{3}He are studied using dispersion relations. It is found that the large distortions represented by the cuts, which have previously prevented dispersion relations from being a practical tool for nuclear physics, can be handled using the conformal mapping techniques of Cutkosky. The method could have general applicability for nuclear physics. (auth)

52069 CRITERIA FOR THE ELIMINATION OF DISCRETE AMBIGUITIES IN NUCLEAR OPTICAL POTENTIALS. Goldberg, D. A.; Smith, S. M. (Univ. of Maryland, College Park). Phys. Rev. Lett.; 29: No. 8, 500-3(21 Aug 1972).

The elastic scattering of composite projectiles by nuclei is considered in the semiclassical limit. Criteria based on this description are obtained for the incident energy and angular range of data necessary to eliminate discrete ambiguities in optical potentials for such projectiles. The effectiveness of these criteria is demonstrated for elastic α scattering data. (auth)

52070 NUCLEAR FORCES AND NUCLEAR-MATTER PROPERTIES. Wong, Chun Wa; Sawada, Tatsuro (Univ. of California, Los Angeles). Ann. Phys. (N. Y.); 72: No. 1, 107-38(Jul 1972).

The saturation properties in nuclear matter of six realistic nucleon–nucleon potentials are examined from the viewpoint of the hole–line expansion of Bethe and Brandow. On-shell uncertainties of nuclear-matter properties are discussed. Off-shell uncertainties are studied with the help of phase-equivalent potentials. The range of off-shell uncertainties due to uncertain knowledge of short-range ($\lesssim$ 1 fm) nucleon–nucleon force is found to be 5 to 10 MeV/A at normal density (k_F = 1.36 fm^{-1}). The total $l > 0$ contribution is estimated to be −1.5 ± 1.5 MeV/A at normal density. The role of tensor force in nuclear saturation is studied. A method for calculating the excitation parameter κ self-consistently but without iteration is described. (9 figures, 6 tables) (auth)

52071 EFFECT OF THE N = 108 DEFORMED SHELL ON NUCLEAR PROPERTIES. Jastrzebski, J. (Inst. of Nuclear Research, Swierk, Poland). Acta Phys. Pol.; B3: No. 3, 397-402 (1972).

Experimental facts related to the closure of a subshell for N = 108 are summarized. It is suggested that this closure stabilizes the deformed shape of even W and Os nuclei. (auth)

52072 EXPANSION PROCEDURES FOR A JASTROW-TYPE CORRELATED WAVE FUNCTION. Fantoni, S. (Univ., Pisa, Italy); Rosati, S. Nuovo Cim.; 10A: No. 1, 145-58(1 Jul 1972).

Various expansions to study the ground states of nuclei by using Jastrow-type correlated wave functions are discussed. The expansions are based on the Van Kampen decomposition method, or are developed as a power series in the parameter α of the two-nucleon correlation function $f(r) = [1 + \alpha h(r)]^{1/2}$. Detailed numerical calculations were performed on the ground state of ^{4}He by means of a central, soft-core nucleon–nucleon potential; the results are promising also from the point of view of a possible extension of the calculation to heavier nuclei. (auth)

52073 VARIATIONAL APPROACH TO THE ON- AND OFF-SHELL T MATRIX. Sloan, Ian H.; Brady, T. J. (Univ. of Maryland, College Park). Phys. Rev., C; 6: No. 3, 701-9(Sep 1972).

A variational procedure for calculating the two-body T matrix $T_l(p,p'; s)$ is proposed, and studied numerically for the case of the Reid $^1S_0$ soft-core potential. The method is based on a variational principle of the Schwinger type, in which the trial functions are themselves off-energy-shell T matrices with fixed s and p (or fixed s and p′), which are expressed as linear combinations of a convenient basis set. The variationally calculated T matrix turns out to have the interesting form $T = V + VG'V$, where G' is a finite-rank approximation to the full Green's function, of rank equal to the number of basis functions. It also turns out that for potentials of finite rank the approximation is exact, provided that the space spanned by the basis functions includes the form factors of the potential. Numerical results are given for the Reid potential at energies from −50 to 300 MeV, and show good convergence for both on- and off-shell T-matrix elements. The nonvariational estimates obtained directly from the trial functions also converge quite well, but less rapidly than the variational results. (auth)

52074 INVERSE PROBLEM FOR HEAVY-ION ELASTIC SCATTERING AND THE CONNECTION BETWEEN PARAMETRIZED PHASE-SHIFT AND OPTICAL-POTENTIAL MODELS. Kujawski, E. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., C; 6: No. 3, 709-19(Sep 1972).

A method based on the JWKB approximation is presented for constructing a local potential from a complete set of complex phase shifts at a single energy. By introducing the Sabatier transformation the problem is reduced to solving an Abel integral equation, the solution of which is closely connected with the potential. The resulting optical potential is uniquely determined in the noncritical domain, and its range of validity is in keeping with the JWKB approximation. A direct connection between the phase shifts and the optical potential is thereby established. The above procedure is tested for the scattering of medium-energy α particles, and it is found to be quite reliable over an angular range encompassing the diffraction region. Possible applications of the above method to the elastic scattering of medium-energy heavy ions are discussed. (auth)

52075 THREE-PARAMETER N–N SOFT-CORE CENTRAL POTENTIAL. Narain, Kunwar J.; Agarwal, B. K. (Allahabad Univ., India). Phys. Rev., C; 6: No. 3, 738-40(Sep 1972).

A three-parameter potential of the form $V = V_0 \cos[5/2 \tan^{-1} (r/h)] (r^2 - h^2)^{-n}$, which gives reasonably good fits to known N–N phase shifts up to 300 MeV, is suggested. (auth)

52076 OBSERVABILITY OF NUCLEAR REARRANGEMENT AND CHOICES OF SINGLE-PARTICLE POTENTIALS. Brueckner, K. A. (Univ. of California, San Diego, La Jolla); Meldner, H. W.; Perez, J. D. Phys. Rev., C; 6: No. 3, 773-9(Sep 1972).

The relationship of nucleon removal energies to observed spectra and single-particle eigenvalues is demonstrated by using a removal-time-dependent separation energy. Three different choices of the nuclear single-particle potential are discussed, and the observability of their eigenvalues is explained. It is shown that "observed" spectroscopic factors should vary with energy and that single-particle energies determined by measuring centroids will also vary with incident energy. Possible evidence for these removal-time-dependent effects in (d,t) and (p,2p) experiments is presented, and other experiments are suggested to verify these effects. (auth)

52077 UNIQUENESS OF R-MATRIX PARAMETERS IN THE ANALYSIS OF LOW–ENERGY NEUTRON CROSS SECTIONS OF FISSILE NUCLEI. Adler, D. B.; Adler, F. T. (Univ. of Illinois, Urbana). Phys. Rev., C; 6: No. 3, 986-1001(Sep 1972).

The existence of different sets of R-matrix parameters describing the same cross sections for a given spin–parity state is studied in the context of low-energy neutron reactions in fissile elements. For two fission channels and well-spaced resonances different sets of fission vectors are found describing essentially the same set of cross-section curves. (auth)

52078 GAUSSIAN APPROXIMATIONS FOR THE NUCLEAR COULOMB INTERACTION. Kolb, D.; Cusson, R. Y. (Duke Univ., Durham, N. C.). Z. Phys.; 253: No. 4, 282-8(1972).

The kernel $1/|r-r'| = 1/y$ in the direct term of the average Coulomb potential of the nuclear Hartree–Fock model is approximated by a sum of gaussians in y. For $0.5 \leq y \leq 30$ F, a sixteen-term expression is found such that the direct Coulomb energy is obtained to one part in 10^3. The exchange Coulomb potential is estimated in the statistical model. Applications of these accurate and practical approximations to fission calculations are discussed. (auth) (1 table)

52079 UNITARY-MODEL-APPROACH FOR TENSOR CORRELATIONS IN NUCLEAR MATTER. Weyer, Wolfgang (Univ., Cologne). Z. Phys.; 253: No. 4, 298-308(1972).

The unitary-model approach for nuclear matter is extended to the treatment of tensor forces. Suitable spin-dependent correlations are employed. The method is demonstrated first for the deuteron problem. For nuclear matter calculations and numerical results for the phenomenological soft-core potential of Eikemeier and Hackenbroich are presented. The increase of binding energy by the inclusion of unitary tensor correlations amounts to as much as 5 MeV per particle. (auth) (2 figures, 2 tables)

52080 SIMPLIFICATION OF CLUSTER MODEL CALCULATIONS. Zickendraht, W. (Univ., Marburg, Ger.). Z. Phys.; 253: No. 4, 350-5(1972).

Cluster-model calculations can be simplified by the use of hyperspherical coordinates, one of which has the dimension of a length, while all others are dimensionless. All cluster-model calculations are reduced to a system of coupled differential equations for functions describing the relative motion. One of the usual difficulties, the solution of an integrodifferential equation, is removed by this method. (auth)

52081 DERIVATION OF THE COLLECTIVE MODEL EQUATIONS FROM THE MANY PARTICLE SCHROEDINGER EQUATION. Zickendraht, W. (Univ., Marburg, Ger.). Z. Phys.; 253: No. 4, 356-9(1972).

The kinetic energy operator of A nucleons has been transformed to a set of 6 collective and 3 A − 9 independent single-particle coordinates in a previous publication. The transformation of the collective part of the kinetic energy operator to the form given in the original paper by Bohr is given. (auth)

52082 POTENTIAL ENERGY SURFACES IN THE TWO-CENTER SHELL MODEL. Fabian, W.; Horlacher, G. E. W.; Albrecht, K. (Univ., Frankfurt am Main). Nucl. Phys.; A190: No. 3, 533-47(1972).

The two-center shell model of two equal overlapping spheroids is combined with Lawrence's liquid-drop shapes. Within this framework, potential energy surfaces for nuclei from different mass regions are calculated. In particular, the transition of the ground-state deformation from spherical to deformed is investigated for a sequence of ruthenium isotopes. (auth) (16 figures, 2 tables)

52083 DIRECT INTERACTION THEORY OF PRODUCTION OF HYPERNUCLEI BY MESON SCATTERING. Bloore, F. J.; Middleton, E. (Liverpool Univ.). Nucl. Phys.; A190: No. 3, 565-75(1972).

A calculation is made, by using a direct interaction model, of the differential cross section for the scattering $K^- +$ nucleus $\rightarrow \pi^- +$ hypernucleus. Careful attention is paid to the normalizations in order to obtain a reliable estimate of the absolute magnitude for the process. This is of such a size (≈ 10 mb) as to merit experimental investigation. (auth) (3 figures)

52084 STABILITY OF NUCLEAR ROTATIONAL STATES. Sano. M.; Takemasa, T.; Wakai, M. (Osaka Univ.). Nucl. Phys.; A190: No. 3, 471-88(1972).

The stability of rotational states described by using a procedure of the Hartree–Fock–Bogolyubov method is discussed. The stability condition is obtained in a general form, and some of its properties are examined with the aid of simplifying approximations. It is pointed out in conclusion that the Coriolis force might lead to the instability of rotational states for sufficiently large angular momenta. The instability of rotational states is caused by the instability of the pairing density, and also by that of the nuclear density distribution. In the former case it is shown that, below the critical angular momentum, a first-order phase transition takes place and in some cases the rotational band breaks off. In the latter case, it might be considered that the assumption of an axially symmetric deformation is broken or large change of the equilibrium deformation is brought suddenly. Then discontinuous change of the rotational level might be seen at the unstable point. (auth) (7 figures, 1 table)

52085 EXTENSION OF THE SPECTRAL DISTRIBUTION METHOD TO MANY-QUASIPARTICLE SUBSPACES. Nissimov, H.; Arvieu, R.; Bohigas, O. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A190: No. 3, 514-32(1972).

The full BCS Hamiltonian is given as a quasi-particle-conserving part, H_c, and a quasi-particle-nonconserving one, H_{nc}. The moments of H_c can be calculated and propagated to different K subspaces (subspaces of states with a well-defined number, K, of quasi-particles) by French's method. The propagation formulas for the second moment of H_{nc} are given in terms of a small number of basic quantities. The spectral distribution method, applied so far to particle systems, can be therefore transcribed to quasi-particle ones. Expressions for the partial widths are derived, and the extent to which the number of quasi-particles is conserved is studied. A possible truncation of the quasi-particle basis is then considered, and a discussion on the behavior of centroid energies and widths in different cases concludes the paper. (auth) (2 figures, 8 tables)

PHYSICS (PLASMA AND THERMONUCLEAR)

52086 PLASMA PHYSICS INDEX. VOLUME 7, No. 6, 1972. Bibliography. Author Index. Subject Index. Leopoldshafen, Ger.: Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 193p.

This listing contains 597 references on various aspects of the subject. (M.O.W.)

Confinement and Heating

Refer also to abstracts 52111 and 52145.

52087 (AD–737228) ION HEATING VIA TURBULENT ION-ACOUSTIC WAVES. Taylor, R. J.; Coroniti, F. V. (California Univ., Los Angeles. Plasma Physics Group). Feb 1972. 22p. (PPG–111). NTIS.

Three dimensional ion-acoustic turbulence is excited by injecting a cold ion beam into a nonmagnetized plasma with $T_e/T_i > 5$. A rapid, approximately exponential heating of the ion beam is observed along the beam path. The heating rates level off when the ion temperature approaches 0.2 T. The turbulent ion-acoustic wave energy density does not exceed 1 to 3×10^9 T_e. The initial rapid ion beating is accounted for by quasilinear theory. Wave saturation, which occurs before significant dissipation of ion beam energy, is consistent with orbit diffusion string turbulence theory. (auth) (NTIS)

52088 (IPP–6/107) STATIONARY TOROIDAL EQUILIBRIA AT FINITE BETA. Zehrfeld, H. P.; Green, B. J. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Mar 1972. 27p. Dep. NTIS (U. S. Sales Only).

The effects of plasma flow on axisymmetric, self-consistent equilibria in toroidal geometry are studied. The investigation is of considerable interest in relation to hot plasmas confined in toroidal systems with longitudinal current. On the basis of the one-fluid MHD plasma model, a concise formulation is used to elucidate important features of the equilibrium. In contrast to previous flow calculations, which were treated almost exclusively in the low-beta approximation, all beta effects are included. As in the treatment of the full-flow problem at low beta, conditions for equilibrium are found. The form of the description allows a quite general discussion of its nature and existence for finite beta. This shows that there is a close relationship between the solvability conditions for equations arising from integrals of the system, and the nature of the characteristics of the partial differential equation describing the radial force balance. In the case of large aspect ratio, these considerations lead to a generalized Bennett relation and to an expression for plasma displacement exhibiting beta and flow effects. (auth)

52089 (IPPJ–112) PRELIMINARY EXPERIMENT ON CURRENT SUSTAINING IN A MAGNETIZED TOROIDAL PLASMA. Hirano, Keiichi; Mohri, Akihiro; Matsuura, Kiyokata (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1971. 22p. NTIS (U. S. Sales Only).

It is experimentally shown that a traveling magnetic field along a torus induces dc toroidal current in a plasma. The circulating toroidal current changes sensitively when the toroidal magnetic field is applied. The results are explained by excitation of whistler waves. The maximum current achieved is about 180 A. It is found that electrons moving with the traveling wave are trapped in mirror or cusp regions formed by the traveling and the dc toroidal magnetic fields. (auth) (Japan)

52090 (JAERI–M–4700) NEOCLASSICAL DIFFUSION IN A TOKAMAK WITH NONCIRCULAR CROSS SECTION. Tuda, Takasi; Tanaka, Masatoshi (Japan Atomic Energy Research Inst., Tokyo). Feb 1972. 12p. NTIS (U. S. Sales Only).NSA

Collisional cross-field diffusion of a plasma in a tokamak with noncircular flux surfaces is calculated using drift kinetic equations. The cross section of the plasma is assumed to be elliptic and/or triangular. For an elliptic flux surface, the modification of the diffusion coefficient is consistent with the change in the number of trapped particles due to the deformation of flux surface, while the diffusion coefficient is little influenced by a triangular deformation both in the plateau and banana regions. (auth) (Japan)

52091 (UCRL–73806) CONFINEMENT OF HOT ELECTRON PLASMA IN THE SUPERCONDUCTING LEVITRON. Hartman, C. W.; Anderson, O. A.; Birdsall, D. H.; Hooper, E. B. Jr.; Munger, R. H. (California Univ., Livermore. Lawrence Radiation Lab.). 6 Jul 1972. 10p. (CONF-720608–2). Dep. NTIS.

From Meeting of the American Physical Society; Albuquerque, NM. (5 Jun 1972).

Hot electron plasma with $n_{eh} \simeq 10^8$ to 10^{10} cm^{-3}, $T_{eh} \simeq 100$ to 500 keV is produced by 10-GHz heating in sheared magnetic field configurations having (a) tokamak-like trapping, (b) minimum $\partial B/\partial s$, and (c) trapping in minimum $|B|$. In all configurations the onset of cold plasma ($n_{ec} \simeq 10^{11}$ to 10^{12} cm^{-3}) during heating is accompanied by an increase in fluctuations and a decrease in n_{eh} at about the Bohm rate for the cold plasma. Bursts of x rays from the walls are correlated with fluctuations in β suggesting anomalous loss. Turning heating power off before or right at the onset of cold plasma gives $\tau_{hot} \simeq$ several seconds. Puffing cold gas into hot electron plasma after heating gives slow buildup of cold plasma by ionizing collisions for configurations (a) and (b). For (c), cold plasma buildup is accompanied by a small, but anomalous loss of hot electrons. Downward jumps in β are correlated with x-ray emission; strong microwave emission by the plasma is not observed. (auth)

52092 NONSTATIONARY PHENOMENA IN THE DECAY OF A PLASMA IN THE L–1 STELLARATOR. Berezhetskii, M. S.; Sbitnikova, I. S.; Shpigel, I. S. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 10, 423-5 (20 May 1972).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 15: No. 10, 596-9(20 May 1972).

The measurements were performed with single Langmuir probes installed at different azimuths and with a system of five radially placed single probes spaced 6 mm apart. A decaying plasma produced by external injection was studied. Relatively fast density dips, up to 30 to 50% of the value n in the studied region, were observed in the central region of the plasma. Typical oscillograms of density variations are given. (M.O.W.)

52093 ION AND ELECTRON ENERGY DISTRIBUTIONS IN A STELLARATOR DIVERTER. Atamanov, N. S.; Zalkind, V. M.; Zykov, V. G.; Il'enko, B. P. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 292-5(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 367-71(Feb 1972).

An experimental study is reported of the energy spectra of a plasma produced by a plasma accelerator and of a plasma trapped in a stellarator divertor. It is shown that plasma electrons are heated through a polarization interaction. (auth)

52094 NEOCLASSICAL TRANSPORT IN TOKAMAKS IN BANANA/PLATEAU REGIMES. Hinton, F. L. (Univ. of Texas, Austin); Wiley, J. C.; Duechs, D. F.; Furth, H. P.; Rutherford, P. H. Contract AT-(11-1)-3073. Phys. Rev. Lett.; 29: No. 11, 698-701(11 Sep 1972).

The predictions of the full two-regime neoclassical transport theory are obtained by numerical computation; they are compared with observations on the ST Tokamak. (auth)

52095 THERMAL DECAY OF AN INFRARED-LASER-HEATED ARC PLASMA. Jassby, D. L.; Marhic, M. E. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 29: No. 9, 577-80(28 Aug 1972).

A small region of a magnetically confined, fully ionized arc plasma of density 2×10^{16} cm^{-3} and electron temperature of 1.3 to 1.7 eV is heated by 0.7 eV with pulsed CO_2-laser energy. The measured thermal decay is accounted for by classical collisional diffusion along the magnetic field. (auth)

52096 COMPUTATION OF STABLE EQUILIBRIA IN MINIMUM-B MIRROR DEVICES. Anderson, David V.; Killeen, John (Univ. of California, Livermore. Univ. of California, Davis). J. Comput. Phys.; 10: No. 1, 133-50(Aug 1972).

A three-dimensional code is presented that solves for plasma equilibria in open-field geometries, permitting analysis of most minimum-B mirror systems. Open confinement with $p = \rho(B)$ only requires the hydromagnetic equilibrium equation to reduce to one elliptic, scalar partial differential equation involving a tensor pressure. The finite-difference form of the equation is solved by an implicit iterative algorithm similar to the ADI (alternating direction implicit) method. Cylindrical grid coordinates are employed, and the mesh spacing is variable to allow representation of far boundary conditions. The program was time-optimized, so the memory requirements are large. It is found that, when the threshold for hydromagnetic instability is passed, the hydromagnetic equilibrium equation becomes hyperbolic, which leads to an ill-posed problem as predicted by Grad. Equilibria are found for an increasing sequence of pressures until the instability threshold is reached. The present code utilized planes of inversion symmetry, common to many minimum-B devices, to allow a reduction in the domain to be studied; Ioffe bar devices, Baseball II, 2X-II, and the proposed mirror fusion experiment are representable. Sample results are presented for Baseball II and the Ioffe bar device, including cases near the high-beta instability threshold. (auth)

52097 TEMPERATURE DISTRIBUTION IN PLASMA HEATED BY A RELATIVISTIC ELECTRON BEAM. Alikhanov, S. G.; Konkashbaev, I. K.; Musher, S. L. (Inst. of Nuclear Physics, Novosibirsk, USSR). Plasma Phys.; 14: No. 7, 743-5(Jul 1972).

Stationary solutions of the energy balance equation are investigated for plasma heated by a relativistic electron beam. The plasma pressure is assumed constant. It is shown that periodic solutions exist for the parameters when the retardation length of the beam is much longer than the characteristic dimension of the system. (auth)

52098 ELECTRON HEATING EFFECT ON POWER BALANCE IN MIRROR REACTORS. Haste, G. R.; Lazar, N. H. (Oak Ridge National Lab., Tenn.). Plasma Phys.; 14: No. 7, 729-35(Jul 1972).

The use of auxiliary power to heat the electrons in a mirror reactor is considered. In this manner the electron temperature is raised so that the ion cooling rate is reduced and the ion confinement is improved. The power required to raise the electron temperature is estimated using the charged particle power balance equation. The merit of this scheme is shown to depend on the efficiency for heating the electrons, as well as the ion injection energy. It is shown to be beneficial for ion injection energies <100 keV, provided the efficiency for heating the electrons is greater than the ion injection efficiency. (auth)

52099 INVESTIGATION OF ELECTRON-RUNAWAY IN THE SLOW TOROIDAL θ-Z PINCH, LT1. Morton, A. H.; Srinivasacharya, K. G. (Australian National Univ., Canberra). Plasma Phys.; 14: No. 7, 687-700 (Jul 1972).

An investigation, based on the measurement of thick target bremsstrahlung, was made of the runaway electrons in the device LT1. The method differed from those usually employed for the detection of the presence of runaway electrons in two respects. First, a target was inserted into the plasma to sample the electrons at various plasma radii and, secondly, the x-ray detection equipment was calibrated in terms of the energy of the electrons producing the radiation rather than in terms of the radiation itself. The experimental results indicated that the runaway occurred mainly at a plasma radius of about 4 cm as would be expected from the radial variation in electron density and temperature. The energy distribution was obtained for electrons striking the target and estimates made of the average runaway rate. (auth)

52100 NEOCLASSICAL DIFFUSION IN AN ELLIPTICAL TORUS. Strauss, H. R. (Univ. of Texas, Austin). Phys. Rev. Lett.; 29: No. 8, 462-4(21 Aug 1972).

Neoclassical transport theory is applied to a plasma in an axisymmetric toroidal magnetic field whose flux surfaces have elliptical cross sections. The contribution of the poloidal field component is important and leads to a large fraction of trapped particles. (auth)

52101 RELATIVISTIC CYCLOTRON RESONANCE HEATING. Faulconer, David W.; Liboff, Richard L. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 15: No. 10, 1831-41(Oct 1972).

The relativistic motion of a single particle undergoing cyclotron resonance in a magnetic mirror trap is studied. The Krylov–Bogolyubov method of averaging is employed to derive equations indicating an upper bound on particle energy. Smallness parameters necessary for the validity of these equations are made explicit. Limitation on particle energy absorption is found for a much broader class of particles than previously known. The relationship of this to experiment is discussed. (auth)

Diagnostics

Refer also to abstract 52202.

52102 (AD–735307) DUAL MAGNETIC PROBE SYSTEM FOR PHASE MEASUREMENTS IN THERMAL INDUCTION PLASMAS. Report for June 1970–April 1971. Eckert, Hans U. (Aerospace Corp., El Segundo, Calif.). 30 Nov 1971. Contract F04701-71-G-0172. 37p. (SAMSO-TR–71-317). NTIS.

Previously reported measurements of rf magnetic field distributions in thermal induction plasmas by a water-cooled coil probe were extended to phase measurements through the use of a second identical probe placed at a fixed position near the plasma boundary. From measurements of the vector sum and/or difference in addition to the individual signals from both probes, data for the variation of the phase angle with radius were obtained. The reliability of the method was checked with an electrolyte of known conductivity. Tests conducted at 2.6 MHz in a 14 cm wide argon plasma column at ambient pressure yielded a change in phase angle of 285 degrees over the radius. The variations in phase and magnitude of the magnetic field were used to derive those of the induced electric field, the current density, the electrical conductivity, and the real part of the Poynting vector. From the latter a specific power input of about 1500 W/cm was obtained. (auth) (NTIS)

52103 (AD–736953) MICROWAVE AND SPECTROSCOPIC ANALYSES OF PULSED AND CONTINUOUS GASEOUS PLASMAS. Final Scientific Report, March 1, 1969–August 31, 1971. Sexton, M. C. (University Coll., Cork (Ireland). Dept. of Electrical Engineering). 15 Nov 1971. 14p. (AFOSR-TR–72-295). NTIS.

Microwave and spectroscopic methods were used to analyze afterglow processes in helium, argon, hydrogen, and deuterium plasmas over the electron density range 10^{13} to 10^{10} per cm^3. Simultaneous measurements of electron temperature, density, and gas temperature confirmed the presence of collisional radiative recombination. The effects of a variable electron radial distribution on the locations of Tonks–Dattner resonances in mercury and rare-gas positive columns were monitored using a dual microwave cavity system. Subsequent measurement of the association electron temperature variation using a low noise radiometer enabled correlation with the radial distribution data to be achieved. (auth) NTIS)

52104 (IPPJ-DT–26) INSTRUMENTATION FOR PLASMA ELECTRON DENSITY WITH HIGHLY SENSITIVE LASER INTERFEROMETERS. Yasuda, Akio; Takeda, Susumu (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1971. 21p. (In Japanese). NTIS (U. S. Sales Only).

The measurable range for electron density in plasma is limited at a minimum value, i.e., 10^{16} cm^{-3}, when conventional interferometers with visible rays are used. To lower the measurable density, various technical improvements were investigated. There are two methods for the improvement, including the use of light sources of longer wavelength such as infrared radiation and the use of highly sensitive interferometers that can detect fine fringe shifts of the visible rays. The latter method is superior to the former in many respects, but it must overcome disturbances induced by mechanical vibrations or drift of the instruments. Technical developments to improve optical interferometers are reviewed, and details of highly sensitive He–Ne laser interferometers developed are described. Three methods, respectively designed for transient, stable, and quasi-stable plasma are discussed. It found that these methods can easily detect the fine fringe shift against the presence of the disturbance induced by vibration or drift. Since this technique can be extended to interferometers of shorter wavelength, further decreases of the minimum measurable density will be attained. (Japan)

52105 (UCRL–50022-1) LLL LASER PROJECTS REPORT NO. 1. Kachen, George I.; Shaw, Gary (eds.) (California Univ., Livermore. Lawrence Livermore Lab.). May 1972. Contract W-7405-Eng-48. 41p. Dep. NTIS.

Nine reprints from other LRL reports are included. They are: (1) laser-produced plasmas for x-ray studies, (2) double-discharge CO$_2$ laser, (3) plasma production with LLL's long-path, Nd-glass disk laser, (4) mode-locked CO$_2$ laser with single-pulse selection, (5) ultrafast streaking camera for laser diagnostics, (6) theory and kinetics of hf lasers, (7) experiments with hf chemical lasers, (8) short-pulse hf oscillator, and (9) short-pulse, solid-state oscillators. (M.O.W.)

52106 USE OF POSITIVELY BIASED ELECTROSTATIC PROBES TO OBTAIN ELECTRON DENSITY IN COLLISIONLESS FLOWS. Dunn, Michael G. (Cornell Aeronautical Lab., Buffalo). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 8, 996-9 (Aug 1972).

Voltage-swept thin-wire electrostatic probes were used to obtain the electron density in the freestream flow of a reflected-shock tunnel and in the boundary layer over a flat plate located in this expanding-flow environment. The voltage sweep was sufficient to permit electron-density determination from both the ion- and electron-current portions of the probe characteristic while the electron temperature was determined from the electron-retarding region. The electron density determined from these two portions of the probe characteristic were in good agreement with each other and with independent microwave measurements for the freestream experiments. Laframboise's free-molecular flow theory was used to deduce the number-density results presented here. (auth)

52107 MEASUREMENT OF THE LOCAL ELECTRON DENSITY BY MEANS OF DIRECT-READING MICROWAVE INTERFEROMETER. Zakrzewski, Z.; Sicha, M.; Lubanski, M.; Kopiczynski, T. (Inst. of Fluid-Flow Machines, Gdansk, Poland). Czech. J. Phys.; 22: No. 8, 641(1972).

A microwave x-band interferometer is described in which a Lecher-wire system has been applied. The interferometer is suitable for dynamic and local measurements of the electron density in plasma. The sensitivity of the interferometer for a 50-mm path of microwaves in plasma is about 4×10^9 cm^{-3}. The spatial resolutions in two directions perpendicular to the Lecher line axis is about 10 mm and 5 mm. (auth)

52108 MEASUREMENT OF ELECTRON TEMPERATURE AND DENSITY BY LASER RADIATION SCATTERING IN TUMAN-2. Gusev, V. K.; Malyshev, G. M.; Razdobarin, G. T.; Sokolova, L. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 271-3(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 340-3(Feb 1972).

Scattered laser radiation is measured in Tuman-2 at an angle of 140°. The electron temperature and density are measured with the plasma heated by the discharge current. With currents of 4.5 to 9 kA, the electron temperature and density are 6 to 10 eV and (3 to 4) $\times 10^{13}$ cm^{-3}, respectively. (auth)

52109 THEORETICAL STUDY OF THOMSON SCATTERING EFFECT OF THE STATISTICAL PROPERTIES OF RADIATION. Eymery, R.; Millet, J. (Univ., Aix-Marseille). J. Phys. (Paris); 33: No. 2-3, 191-6(1972). (In French).

The statistical properties of intense electromagnetic radiation affect the Thomson scattering transition probability in two ways: a correction for the free electron propagator due to forward scattering must be introduced; a transition probability dependence on the density matrix of the field must be taken into consideration. The form of the density matrix of the scattered mode is determined. The Thomson effect is compared for the cases of coherent and thermal light. (France)

52110 FOUR METHODS OF MEASURING THE PLASMA ION ENERGY TRANSVERSE TO A MAGNETIC FIELD. Chambers, R. G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 7, 747-53(Jul 1972).

Methods of measurement considered, which are applicable only in linear magnetic field systems, were: a method using a conventional gridded energy analyzer; a calorimetric method; a method that directly measures the Larmor radius of the ions, from which the ion perpendicular energy may be inferred; and an adaptation of this which is experimentally simpler but justified only when the transverse ion energy is greater than the perpendicular ion energy. (auth)

52111 SPECTROSCOPIC STUDY AND ENERGY BALANCE OF PULSED TOROIDAL DISCHARGES. Irons, F. E.; Ellis, W. R.; Newton, A. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 7, 717-28(Jul 1972).

Investigations of plasma produced by a pulsed current in a quartz torus in hydrogen are described. Spectroscopic investigations of the plasma from the start of that current pulse to the afterglow are presented. Radial distributions of electron temperature and density are inferred from space resolved measurements of the line Hα and the continuum at $\lambda = 4961$ Å. These show that the plasma has a density of 1.5×10^{15} cm^{-3}, which falls to 8×10^{13} cm^{-3} at 180 μs, with corresponding electron temperatures ranging from 2×10^4 to 4×10^3°K. Dissipation of the toroidal current provides 15 to 20 times the energy required for full ionization, and temperature equilibrium results from atom thermal conduction loss to the wall. Although these losses can be intrinsic, the observed symmetries in luminosity and magnetic field show that MHD instability is present which enhances the wall contact. (auth)

52112 PLASMA DIAGNOSTICS BY LASER. Miyamoto, Kenro (Nagoya Univ., Japan). Oyo Butsuri; 41: No. 1, 59-63 (Jan 1972). (In Japanese).

The measurement of plasma density by the interference method and by holography, and measurements of magnetic fields from Faraday rotary polarization are described. There are two methods for upgrading the sensitivity of density measurements; to increase laser wavelengths and to detect minute fringes. Three features are indicated for the density measurement by holography. Since the Faraday rotary polarization is a function of the magnetic field, field intensity within the plasma is determined by the measurement, and the external field intensity can be easily measured. Finally, plasma pressure can be determined. (Japan)

52113 PLASMA INVERSE SCATTERING THEORY. Balanis, George Nick. Pasadena, Calif.; California Inst. of Tech. (1972). 134p. University Microfilms Order No. 72-22,541. Thesis.

The electron density profile of plane stratified inhomogeneous plasmas is calculated. The electron density profile is obtained through a numerical solution of the inverse scattering algorithm. The inverse scattering algorithm connects the time-dependent reflected field resulting from a δ-function field incident normally on the plasma to the inhomogeneous plasma density. Examples show that the method produces uniquely the electron density on or behind maxima of the plasma frequency. It is shown that the δ-function incident field used in the inverse-scattering algorithm can be replaced by a thin square pulse. (Diss. Abstr. Int., B)

Kinetics (General)

52114 (FRNC-R-6) CONFERENCE ON HOLLOW-CATHODE DISCHARGES AND THEIR APPLICATIONS, ORSAY, FRANCE SEPTEMBER 20-23, 1971. Minoo, H. (ed.) (Paris Univ., Orsay (France). Laboratoire de Physique des Plasmas). 69p. (CONF-710955).

A total of 25 papers were presented under the following headings: glow discharges; arc discharges; high voltage discharges and other types of hollow-cathode discharges; plasma sources; discharge tubes; radiation sources; sources of electrons, ions, and metastables. (France)

52115 (IPP-9/4) SURFACE PROBLEMS IN PLASMA PHYSICS AND FUSION RESEARCH. Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1972. 24p. Dep. NTIS (U. S. Sales Only).

An outline is presented of plasma-wall interaction. A few of the relevant surface-physics effects are discussed. It is pointed out that desorption and backscattering are of importance for plasma-physics experiments, while for a steady-rate fusion reactor, sputtering and backscattering will probably be the most important surface effects. (auth)

52116 (IPPJ-113) DEPENDENCE OF PLASMA DENSITY FLUCTUATION ON ELECTRIC FIELD CONTROLLED BY METAL ENDS. Uramoto, Johshin (Nagoya Univ. (Japan). Dept. of Plasma Physics). Nov 1971. 8p. NTIS (U. S. Sales Only).

Density fluctuations in a plasma streaming along a uniform magnetic field B are investigated for controlling an electric field across B through two metal end plates. The fluctuations decrease to a minimum when the electric field approaches zero. However, the fluctuations are local and not related to an enhanced diffusion. (auth) (Japan)

52117 (KHFTI-71-10) RADIATION OF ELECTRON CYCLOTRON HARMONICS BY PLASMA WITH A GROUP OF UNBALANCED ELECTRONS. Vasil'ev, M. P.; Kuznetsov, Yu. K.; Pavlichenko, O. S.; Starikov, V. N. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 31p. (In Russian). Dep. NTIS (U. S. Sales Only).

The radiation of a steady-state discharge was investigated at the harmonics of electron cyclotron frequency. Consonant with the well-known radiation of cyclotron harmonics of a plasma discharge, which has a comparatively low level and line width (2 to 3%), radiation of another type was generated under the defined conditions. The lines of this radiation had a width of 1 to 0.5%, and its power was somewhat higher. The radiation was generated by brief (1 to 5 μsec) pulses, and the temperature of the plasma reached 10^8 eV. Other branches of radiation were studied for frequencies that differed from cyclotron radiation and its harmonics. Experimental data were compared with the results of theory. The basic properties of radiation were readily interpreted in terms of the excitation in a plasma of longitudinal electron oscillations by a group of nonequilibrium electrons with an isotropic function of velocity distribution. (tr-auth)

52118 (LA-tr-72-24) SNOW-PLOW COMPUTATION IN PLASMA FOCUS. Rapp, H.; Trunk, M. Translated for Los Alamos Scientific Lab., N. Mex., from report IPF-71-1. 35p. Dep. NTIS.

The acceleration process is investigated mainly as a function of the various parameter variations. The values of the current, the phase velocity, and the related energy terms at the first point of maximum current are studied. The compression process was studied as a function of time and the pinch radius. Also, the effects of the inductance of the energy reservoir are investigated. (M.O.W)

52119 PHOTON-PLASMON TRANSITION $2S_{1/2}-1S_{1/2}$ IN HYDROGEN-LIKE ATOMS. Kaplan, S. A.; Kleiman, E. B. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 2, 305-7(1972). (In Russian).

The probabilities of the two-quantum induced (according to the plasmon number) photon-plasmon transition $2S_{1/2}-1S_{1/2}$ are calculated for hydrogen-like atoms. In a turbulent plasma medium, this process may be more effective than the ordinary two-photon radiation and collisions. (auth)

52120 EFFECT OF RESONANCE RADIATION ON THE PLASMA IN A CESIUM DISCHARGE. Morgulis, N. D.; Przhonskii, A. M. (Kiev State Univ.). Sov. Phys.-Tech. Phys. (Engl.

Transl.); 17: No. 2, 274-7(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 344-8(Feb 1972).

The effect of intermediate excitation of the cesium atom to the 6P resonance state on the plasma in a cesium discharge was studied. The plasma is subjected to additional external illumination by the resonance radiation of cesium. Experiments have shown that illumination of this kind has an important effect on the plasma, increasing the charge density and reducing the electron temperature, the electric field, and the power consumption. However, in contrast to the photoresonant plasma, there is no disturbance of the electron Maxwellian energy distribution or of the electron radial distribution. Mass-spectrometer analysis shows that the increase in ionization during illumination is connected with the appearance of atomic ions in the plasma. These results lead to the following conclusions: 1) Illumination of this kind probably plays an appreciable role even in the case of the ordinary discharge plasma, and 2) this phenomenon is not connected with associative ionization, but with collisional ionization of photoexcited cesium atoms. (auth)

52121 MECHANISM OF CHARGED-PARTICLE ACCELERATION IN A DYNAMIC Z PINCH. Kvartskhava, I. F.; Matveev, Yu. V.; Reshetnyak, N. G. JETP Lett. (USSR) (Engl. Transl.); 15: No. 10, 437-40(20 May 1972).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 15: No. 10, 619-22(20 May 1972).

Discharges in deuterium were investigated in the pressure range 5 to 2 $\times 10^{-2}$ mm Hg. Oscillograms of the discharge are described. Charged particle acceleration mechanisms in the discharge are discussed. (M.O.W.)

52122 PLASMA ACCELERATION IN A CONICAL INDUCTION SOURCE. Churaev, V. A.; Petrov, V. N. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 296-300(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 372-8(Feb 1972).

Calculations are made for plasmoid acceleration with an inductor whose power supply is an actual capacitor bank. The solution of the equation system defines the parameter region in which acceleration is possible and makes it possible to determine the conditions for optimum acceleration. (auth)

52123 MONOCHROMATICITY OF A PULSED ABLATION ACCELERATOR. Gubarev, V. Ya.; Kozlov, N. P.; Leskov, L. V.; Protasov, Yu. S. (Moscow Higher Technical School). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 301-2(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 379-81(Feb 1972).

The monochromaticity of a pulsed ablation plasma accelerator is investigated. A method based on the solution of the equation of motion in the one-dimensional hydrodynamic approximation, taking account of the radial inhomogeneity of the magnetic field, is proposed for the approximate calculation of the monochromaticity. (auth)

52124 MEASUREMENTS OF HALFWIDTHS OF SOME ARGON LINES IN A WALL-STABILIZED CASCADE ARC. Tonejc, A. M.; Acinger, K.; Vujnovic, V. (Univ., Zagreb). J. Quant. Spectrosc. Radiative Transfer; 12: No. 9, 1305-12(Sep 1972).

The Stark broadening of Ar I 7147.04, 7272.93, 7067.2, 6965.43 Å lines was investigated in a wall-stabilized argon-arc plasma. The temperature was varied from 10,100 to 12,500°K, and the electron density from 1.9 to 8.8×10^{16} cm^{-3}. In the observed plasma conditions, the last two lines were self-absorbed owing to their optical depths. Correction to the optically thin line was made, and the quadratic Stark-effect halfwidths were compared with the theoretical halfwidths published by Griem (Phys. Rev., 128: 515(1962)). Within the limits of experimental error, the halfwidths of lines of 7147, 7273, 6965, and 7067 Å were found to be in agreement with theory. (auth)

52125 DETERMINATION OF THE STARK CONSTANTS OF XENON LINES. Lesage, A.; Richou, J. (Observatorie de Paris, Meudon, France). J. Quant. Spectrosc. Radiative Transfer; 12: No. 9, 1313-18(Sep 1972). (In French).

Spectroscopic studies of a xenon plasma created in a shock tube lead to a new determination of the Stark coefficients C_4 of the $1s_4-2p_1$, $1s_5-3p_6$, $1s_5-3p_8$, $1s_5-3p_9$, and $1s_4-2p_3$ transitions. The results are compared to Ryde's measurements and interpreted according to Lindholm's theory and quantum-mechanical calculations. (auth)

52126 CHERENKOV EFFECT IN AN ALTERNATING ELECTRIC FIELD. Diasamidze, Zh. M.; Tavdgiridze, T. L. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 226-33(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 282-91(Feb 1972).

The energy lost by a charged particle moving in an alternating electric field through a dielectric above the boundary separating two dielectrics is computed. The alternating electric field, of frequency ω_0, can have a profound effect on the Cherenkov radiation of the charged particle, and leads to the appearance of Doppler radiation at a frequency greater than ω_0. At small amplitudes of the electric field the Cherenkov radiation is reduced slightly and the Doppler radiation increases as the square of the amplitude. A marked reduction in the energy losses in Cherenkov radiation is possible at large amplitudes of the electric field. (auth)

52127 SELECTED ATOMIC PARAMETERS FOR LASER-GENERATED BARIUM PLASMAS. Davis, J. (Science Applications, Inc., Arlington, Va.). J. Quant. Spectrosc. Radiative Transfer; 12: No. 9, 1351-6(Sep 1972).

The development of high energy lasers has made it possible to generate barium plasmas under controlled laboratory conditions in an attempt to simulate high-altitude chemical releases. Focusing the laser energy on barium pellets or vapor generates a hot, dense plasma whose subsequent morphology closely resembles that of high-altitude barium clouds. In order to assess the results of these experiments and evaluate the quality of the simulation, reliable estimates on some of the radiative properties of the plasma are required. Results of calculations are presented on the combined electron impact and Doppler widths of selected spectral lines of BaI, II, and SrI. (auth)

52128 INJECTOR FOR FAST ATOM BUNCHES. Kartashev, K. B.; Pistunovich, V. I.; Platonov, V. V.; Filimonova, E. A. (Inst. of Atomic Energy, Moscow). Plasma Phys.; 14: No. 7, 737-42(Jul 1972).

A device is described for generating a dense flux of hydrogen atoms by charge exchange on magnesium vapor of a plasma blob generated by a coaxial plasma gun. Results of the experimental investigation of the flux of fast atoms are described. (auth)

52129 ASYMMETRY OF LYMAN-α IN A DENSE HYDROGEN PLASMA. Bacon, M. E. (Univ. of Natal, Durban, S. Afr.). Phys. Lett.; 41A: No. 1, 43-4(28 Aug 1972).

The asymmetry of the Lyman-α line is calculated. The quasistatic approximation is used to treat the ion perturbers and the impact approximation is used to treat the electron perturbers. Following Sholin, lowest-order asymmetry terms arising from the quadrupolar ion—atom interaction are included. Disagreement between theory and experiment is found. (auth)

52130 CALCULATIONS FOR COUPLED RADIATIVE AND COLLISIONAL EFFECTS IN A CYLINDRICALLY CONFINED ARGON PLASMA. Giannaris, Robert James. Lafayette, Ind.; Purdue Univ. (1972). 221p. University Microfilms Order No. 72-21,194.

Thesis.

Nonequilibrium excitation in argon arc plasmas was examined. A BKM-type model was formulated to account for the effects of collisional and radiative coupling between the neutral-argon-atom bound levels in an arc plasma of known thermochemical properties. A numerical solution was obtained for the equation of radiative transfer for an infinite, axisymmetric, cylindrically confined medium with variable thermochemical properties and was used to calculate absorption-rate coefficients for selected transition arrays in the argon atom. The absorption rate coefficients were coupled with the BKM model to determine the effects of absorption on the bound state populations of the argon atom. The radial distribution of the neutral argon 4p level is determined by spectroscopic and numerical methods. The difference between the results obtained is attributed to excitation nonequilibrium effects. However, where previous spectroscopic studies revealed that a secondary peak in the 4p level population occurs near the wall of high and low current argon arcs, the numerical results of this study show that this effect should only be present in the low current arc. The principal contributors to nonequilibrium excitation in argon arc plasmas are found to be resonance absorption and optically thin radiation emission in the upper bound levels. The radiation model is also used to examine line-emitted radiative wall heat flux. It is found that, of the upper level transitions, only lines in the 4s—4p transition array suffer appreciable absorption in their emitted flux. Parametric studies are performed for the heat flux emitted by this array. It is found that the percent of emitted flux absorbed in the plasma is relatively unchanged by variations in arc current, but increases with arc pressure and arc radius. (Diss. Abstr. Int. B)

52131 MOTION OF A STREAMING PLASMA IN A SHORT SOLENOID MAGNETIC LENS. Bush, Charles Edward. Madison, Wis.; Univ. of Wisconsin (1972). 227p. University Microfilms Order No. 72-18,971.

Thesis.

A facility was constructed to study a number of pulsed plasma sources for injection into various magnetic fields. The facility consists of the source, high-vacuum drift tank and apparatus, and precision pulsing and timing circuitry. A coaxial source was studied in some detail. The purpose of this study was to develop a source to generate a plasma of 10^{19} ions at an energy of at least 100 eV. The operating parameters of the source were optimized, and a plasma of $>2 \times 10^{19}$ ions at an average streaming energy of 30 to 40 eV was obtained. It was also found that the gun discharge could interact with the metal walls of the drift tank. Insulation of the source from the tank was found to reduce this interaction. The main experiment was a study of the nature of the interaction between the source plasma and the field of a short solenoid or magnetic lens. The long-range goal of this study was the possibility of using such a field to focus and guide a plasma into a confinement device such as the Wisconsin Levitated Octupole. The short solenoid was found to be a good guide field. In addition, increases in plasma flux downstream indicated some form of particle focusing. Magnetic probe data also showed the field to be severely depressed within the streaming plasma. Complete field suppression on axis was realized up to relatively high fields. A model was developed for a high-β collisionless plasma-field interaction. This model was based on formation of a boundary at which the pressure of the pulsed streaming plasma and magnetic field pressure balanced. In the ideal model the field is assumed to be completely suppressed throughout the plasma. Particles within the plasma core then move in a field-free region. The equation resulting from the model were solved numerically. Qualitative agreement between the model and experimental results was very good. However quantitative comparisons were made difficult due to difficulty in determining the exact functional dependence of the resulting perturbed magnetic field. The increased particle flux at positions downstream from the focus coil was found to be the result of plasma ions being specularly reflected from the boundary. Depending on the shape of the resulting boundary, reflected particles can be focused at positions downstream. The specular reflection model appears to be especially applicable for fields of 800 gauss or less. (Diss. Abstr. Int., B)

52132 LINEAR AND NONLINEAR IMPULSE STIMULATED EMISSION FROM A PLASMA COLUMN. Sindoris, Arthur Richard. New York; New York Univ. (1971). 170p. University Microfilms Order No. 72-21,789.

Thesis.

An experimental study of linear and nonlinear impulse stimulated emission from a transversely excited, low-temperature, inhomogeneous plasma column is presented. At the linear level, the measurements indicate that the characteristic frequency of the emission is the Tonks resonance frequency of the column and the damping is predominantly caused by phase mixing. The fluid-model description of a plasma, applied to an inhomogeneous slab, predicts this behavior. A 1.9 kV, 120-ps baseband pulse is used to drive the impulse stimulated emission into the nonlinear regime without altering the background electron density. This nonlinear emission damps more rapidly and oscillates at a slightly higher frequency than the linear response. A digital-computer Fourier-analysis scheme is used to measure the magnitude of the increase in damping and frequency shift. (Diss. Abstr. Int., B)

52133 STANDING STRIATIONS AS SOLUTIONS OF THE PEKAREK EQUATION. Lee, D. A.; Garscadden, A. (Wright-Patterson Air Force Base, Ohio). Phys. Fluids; 15: No. 10, 1826-30(Oct 1972).

Boundary conditions suggested by observations are used with a partial differential equation equivalent to Pekarek's striation model to construct a linear boundary-value problem for the description of time-independent ionization disturbances in the finite positive column. Solutions of this problem display several features of standing striations. (auth)

Kinetics (Experimental)

52134 (AD–735303) EVIDENCE FOR DEPARTURES FROM EQUILIBRIUM IN AN RF INDUCTION PLASMA IN ATMOSPHERIC-PRESSURE ARGON. Report for September 1969–December 1970. Leonard, Stanley L. (Aerospace Corp., El Segundo, Calif.). 1 Aug 1971. Contract F04701-71-C-0172. 25p. (SAMSO-TR–71-312. NTIS.

Spectroscopic observations are reported of an atmospheric-pressure argon plasma generated inductively by a high-power rf oscillator. Values of the excitation temperature T_{ex}, obtained from measurement of the relative intensities of spectral line, were substantially greater than temperature values T_{eq}, determined from absolute continuum and line intensities on the assumption of local thermodynamic equilibrium. If a collisional–radiative plasma model is used, the absolute intensity measurements yield temperatures T_{cr}, which are in better agreement with the T_{ex} values. (auth) (NTIS)

52135 (FRNC-TH–192) STUDY OF THE ELECTRON DENSITY AND ENERGY IN AN INDUCTIVE HF DISCHARGE IN HYDROGEN. Turban, G. (Nantes Univ. (France)). [nd]. 109p. (In French).

Thesis.

Electrostatic probe measurements were made at low pressures (5 to 100 mtorr) in hydrogen in the diffusion limit region. The energy distribution of the more energetic electrons deviates considerably from that suggested by the Maxwell law, and is close to that given by the Druyvesteyn law. This deviation is confirmed by the fact that the triple asymmetric probe measurements do not give the same results as the double symmetric probe measurements. The electron temperature deduced from measurements, made using floating probes at the center of the discharges, diminishes with increasing pressure, and is independent of the applied power. Varying this power does not change the voltage at the terminals of the inductor nor the field induced at the wall of the enclosure, but does directly affect the electron density. The electron temperature increases radially when the discharge is shielded. This radial variation is represented by the energy distribution above the maximum, i.e., for energies between 10 and 25 eV, thus explaining the sensitivity of double symmetric probe to this variation. When the pressure increases this radial dependence diminishes; such a dependence does not exist in the absence of shielding. (France)

52136 ION MOTION IN A MAGNETIC FIELD IN THE PRESENCE OF AN INDUCED ELECTRIC FIELD. Pasechnik, L. L.; Prokhorov, M. M.; Yagola, V. V. (Inst. of Nuclear Research, Kiev). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 220-3(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 275-9(Feb 1972).

An experimental study is described of the motion of helium ions (in helium), perpendicular to a magnetic field, in the presence of the electric field induced by the variable component (several percent) of the magnetic field. Depending on the modulation frequency ω, the time τ associated with the ion motion has resonance properties, being a minimum when $\omega_H = k\omega$, where k = 1, 2, 3 (ω_H is the ion cyclotron frequency). The development of the resonance is studied. Calculations show that the observed accelerated motion of the ions is due principally to parametric resonances between the modulation frequency and the ion cyclotron frequency; parametric acceleration is found to be much stronger than conventional heating in a variable electric field. (auth)

52137 MEASUREMENT OF NONTHERMAL OSCILLATIONS AT THE PLASMA FREQUENCY AND ITS HARMONICS IN A MAGNETIZED ARC PLASMA USING THE HIGH-FREQUENCY STARK EFFECT. Ringler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 41A: No. 1, 15-20(28 Aug 1972).

High-frequency oscillations of the electric field were observed in a magnetized arc plasma using the high-frequency Stark effect. These oscillations seem to appear around the plasma frequency and its harmonics, one order of magnitude above thermal level. The position of the satellites shifts with electron density. (auth)

Kinetics (Theoretical)

Refer also to abstract 51477.

52138 (AD–736615) COMPUTATIONAL AND EXPERIMENTAL PLASMA PHYSICS FOR THEORETICIANS. Fried, Burton D. (California Univ., Los Angeles. Plasma Physics Group). Jan 1972. Contract N00014-69-A-0200-4023. 33p. (PPG–107). NTIS.

The report discusses how a theoretician can actively participate in both computational and experimental plasma physics, avoiding both the tiresome book-keeping associated with conventional programming and the technical complexities of hardware. The author describes the currently operating, on-line mathematical facilities, discusses the experimental devices, and shows some illustrative problems. (auth) (NTIS)

52139 (FEI–263) ELECTRICAL FIELD NEAR THE ELECTRODE IN A PLASMA WITH A CURRENT (THE DEBYE–HUCKEL PROBLEM). Shcherbinin, P. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The problem of permeation of an electric field throughout a plasma with a current is treated. The field consisted of two parts: a quasi-neutral field which decreased slowly with distance, and a rapidly relaxing near-electrode disturbance. Some accurate solutions to the fundamental linear equation are presented. (tr-auth)

52140 PLASMA DECAY IN AN ELECTRICALLY CONDUCTING CYLINDER IN A LONGITUDINAL MAGNETIC FIELD. Chekmarev, I. B. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 203-6(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 253-8(Feb 1972).

The decay of a weakly ionized, collisional, isothermal plasma is analyzed in a cylinder with conducting walls in a longitudinal magnetic field. The neutral portion of the plasma and the sheaths at the end faces and lateral surfaces of the cylinder are studied. Matching the solutions yields a transcendental system for determination of the eigenvalues of the problem, the current, and the potential discontinuities in the Debye sheaths. The damping and potential discontinuities are given for different magnetic fields and relative cylinder lengths and the current is given as a function of cylinder length. (auth)

52141 BOHM–LANGMUIR CRITERION AND BOUNDARY CONDITIONS FOR AN ELECTRIC FIELD IN A PLASMA. Chekmarev, I. B. (Ioffee Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 207-9(Aug 1972).
Translated from Zh. Tekh. Fiz.; 42: No. 2, 259-61(Feb 1972).

A collisionless shielding sheath close to an ideally absorbing, electrically conducting wall is considered. The equations describing the behavior of charged particles in the layer are integrated. Relations are obtained connecting the current and particle densities, the electric potential, and its normal derivative at the external boundary of the layer. These relations serve as boundary conditions for the neutral region of the plasma. Results are given. (auth)

52142 COMPARISON OF SOME PARTICLE-IN-CELL PLASMA-SIMULATION METHODS. Lewis, H. Ralph (United Kingdom Atomic Energy Authority, Abingdon, Eng. Los Alamos Scientific Lab., N. Mex.); Sykes, A.; Wesson, J. A. J. Comput. Phys.; 10: No. 1, 85-106(Aug 1972).

Comparisons between four particle-in-cell methods for plasma simulation in one dimension were made with the objectives of investigating (a) the utility of using a higher-order representation of the scalar potential than piecewise linear, and (b) the effects of smoothing the electric field as opposed to simply calculating it from the gradient of the scalar potential at every point. The potential is represented either as a continuous piecewise linear function of position or as a smooth piecewise quadratic function. Numerical comparisons were made using a simple test problem in which a Maxwellian distribution of positrons streams stably through a Maxwellian distribution of electrons. With various numbers of simulation particles per Debye length, time steps, and grid spacings, the time variation of the relative stream velocity of the positrons and electrons was used to determine a collision time, and fluctuations in total energy and momentum were monitored. The investigations with this test problem indicate that the four methods are similar to one another with regard to collisional effects, although the collisional effects are usually somewhat less pronounced with the smoothed electric field and the piecewise linear representation of the potential. All of the methods exhibit a strong dependence on initial conditions and time step with this test problem. With regard to fluctuations of total energy and momentum, the comparison of the methods depends very much on the grid spacing and time step. (auth)

52143 IMPULSE RESPONSE OF A KINETICALLY DESCRIBED NONUNIFORM PLASMA BOUNDED BY SHEATHS. Frisch, Rudolf A. New York; New York Univ. (1971). 114p. University Microfilms Order No. 72-21,780.
Thesis.

The impulse response of a kinetically defined, nonuniform electron plasma slab bounded by sheaths is obtained. The one-dimensional Vlasov–Poisson system is considered. Electron-free boundaries are specified for all time. Possible equilibrium states are studied; under relatively loose mathematical conditions the electron distribution is separable and the only possible velocity distribution is Gaussian. Admissible initial conditions are investigated. The equilibrium plasma is stimulated by an impulse electric field which imparts upon all electrons an equal additional velocity. A numerical scheme is developed that permits reliable solutions for certain time periods to be obtained, after which numerical instabilities begin to appear. Throughout this study, considering plasma slabs with an equilibrium temperature around 30,000°K and a plasma frequency of approximately 1 GHz at the center of the slab, reliable solutions are obtained for time spans ranging from 2 plasma periods for strong stimuli to 20 plasma periods in linear operation. It is found that, for excitations in the linear region, the Fourier spectrum of the impulse response contains three strong resonances at and below the background plasma frequency at the center of the slab as well as a series of smaller resonances above this frequency. The former are Tonks–Dattner resonances and it is shown that each one is associated with a well-definable region within the slab. The highest of the three high-amplitude resonances is a cold-plasma oscillation, while the other two are shown to be thermomodes in the sense of Bladwin and Ignat. In the nonlinear responses corresponding to strong stimuli, early bunching and wave–particle interaction are observed. (Diss. Abstr. Int., B)

52144 GREEN–KUBO FORMALISM AND CONDITIONS FOR LINEAR RELATIONSHIPS AMONG TRANSPORT COEFFICIENTS. Mjolsness, R. C.; Visscher, William M. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 15: No. 10, 1854-7(Oct 1972).

A short, physically transparent derivation of the Green–Kubo formulas is presented and used to show that when two current operators (e.g., charge, number, energy) are proportional, so are the corresponding transport coefficients. Examples of this consequence are discussed. (auth)

Production

52145 (IPPJ–117) PLASMA GENERATION AND HEATING TO THERMONUCLEAR TEMPERATURE BY LASERS. Yamanaka, C.; Yamanaka, T.; Sasaki, T.; Yoshida, K.; Waki, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1972. 18p. NTIS (U. S. Sales Only).

The neutron yield was observed from a solid deuterium target irradiated by a glass laser beam, the power of which was 20 GW at 2 ns. The estimated threshold of laser power for anomalous heating due to parametric instability was in accord with the experimental result. Beyond this threshold, the increase of the electron temperature, the appearance of a fast ion group, and the anomality of the light reflection from the plasma were discovered. These phenomena were closely correlated with the neutron yield. At the region above a few hundred electron volts, this kind of anomalous heating has an essential role to reach the fusion reaction temperature. (auth) (Japan)

52146 FORMATION OF INTENSE CHARGED-PARTICLE BEAMS IN A CURRENT-CARRYING PLASMA. Suladze, K. V. (Physical-Technical Inst., Sukhumi, USSR). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 459-62(20 Jun 1972).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 648-52(5 Jun 1972).

An investigation is made of the intense charged-particle beams occurring in a current-carrying plasma as a result of a "break" on which the entire potential difference is concentrated. The plasma is fed from a six-channel spark source into a discharge gap, and an electric field is applied to a gap filled with plasma. Necessary conditions for the excitation of the current instability and the occurrence of a "break" in the plasma are given. Results are given of mass and energy analysis of the formed beams. At 20 kV and a cathode hole diameter of 1 cm, the ion-beam current reached 20 A. The critical electron current is 9 kA. (D.L.C.)

52147 LARGE-DIAMETER, QUIESCENT PLASMA IN A MAGNETIC FIELD. Ault, Earl Rema. Los Angeles; Univ. of California (1972). 87p. University Micrifilms Order No. 72-22,153.
Thesis.

The production of a large-volume, uniformly magnetized, warm, quiescent, collisionless plasma, with as high a ratio of plasma pressure to magnetic pressure as possible is discussed. Such a plasma was generated by a high-frequency voltage applied to a fine-wire-grid electrode in various gases at pressures around 10^{-3} torr. Containment was provided by a magnetic bottle in the form of a uniform magnetic field surrounded on all boundaries by high-order multipole magnetic fields. Although a finite-beta plasma, the diameter is large enough to study new effects. Preliminary data show that ion cyclotron harmonic waves were propagated and that the stop bands below ω_{ci} and $2\omega_{ci}$ were observed. Both forward and backward waves are also observed, and their wave numbers compare well with the results of kinetic theory. With improvement in experimental technique it seems likely that this plasma can be used to study nonlinear effects such as parametric decay and mode–mode coupling. (TSS) (Diss. Abstr. Int., B)

Stability

Refer also to abstracts 51182 and 52186.

52148 (AD–736835) INVESTIGATIONS ON PLASMA INSTABILITIES. Final Scientific Report, January 1, 1970–December 31, 1971. Cap, Ferdinand; Herrnegger, Franz (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). 31 Dec 1971. Contract F61052-70-C-0014. 26p. (UNICP-FR–71; AFOSR-TR–72-0357). NTIS.

The report summarizes the research work on plasma instabilities done at the Institute for Theoretical Physics, University of Innsbruck, in the period 1970–1971. The main topics are: Plasma turbulence, local potential in MHD, nonlinear waves, literature survey on plasma instabilities, collisional kinetic equations gravitational instability, numerical investigation of microinstabilities. (auth) (NTIS)

52149 (AD-736951) EFFECTS OF COLLISIONS AND GYROVISCOSITY ON GRAVITATIONAL INSTABILITY IN A TWO-COMPONENT PLASMA. Herrnegger, Franz (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). 28 Dec 1971. Contract F61052-70-C-0014. 24p. (UNICP-SR-76; AFOSR-TR-72-358). NTIS.

The dispersion relation for gravitational instability is derived within the framework of a two-fluid theory. It is shown that the Jeans criterion is changed by finite Larmor radius effects and by collisions for wave propagating perpendicular to the magnetic field. The critical wave number for instability decreases with increasing Alfven velocity and with increasing gyroviscosity. Instability does not set in with overstability. (auth)

52150 (IPPJ-120) TRAPPED-ION INSTABILITIES IN ION-ACOUSTIC WAVE. Ikezi, H.; Kiwamoto, Y.; Nishikawa, K.; Mima, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1972. 33p. NTIS (U. S. Sales Only).

Growth of two types of sideband waves was observed experimentally when a relatively large-amplitude ion-acoustic wave propagates in a collisionless plasma having the electron to ion temperature ratio $T_e/T_i \approx 20$. The theory of the trapped-particle instability well accounts for the frequency spectrum and the frequency and the amplitude ranges of the large-amplitude wave, where the sideband waves grow, and also their growth rates. The sidebands extract the energy from the large-amplitude wave and cause its heavy damping. (auth) (Japan)

52151 (KHFTI-71-40 TOWARD A NON-LINEAR THEORY OF THE INSTABILITY OF A MONOENERGETIC BEAM IN A PLASMA. Matsiborko, N. G.; Onishchenko, I. N.; Shapiro, V. D.; Shevchenko, V. I. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The excitation of a monochromatic wave by a "cold" electron beam is examined. The solution obtained describes the transition from exponential growth of the wave amplitude for a linear stage to an oscillation amplitude associated with beam capture in a potential well that established the wave. The maximum values of the amplitude and oscillation period are found. The cases of nonrelativistic and relativistic beam energies are investigated. (tr-auth)

52152 (ORNL-TM-3943) ELEMENTS OF THE STABILITY OF THE GUIDING-CENTER PLASMA. Guest, G. E.; Hedrick, C. L. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 34p. Dep. NTIS.

Computations are made of the first and second order variations of the total energy of a magnetically confined plasma described by an infinitely conducting guiding-center model. Since the plasma and the magnetic field move together during the displacement, $\vec{\xi}(x)$, both $\vec{B}(\vec{x})$ and the distribution function, $f(\epsilon, \mu, L)$, are altered. However, the potential difficulties associated with the variations of f are largely circumvented by the device introduced by Newcomb and exploited by Kruskal and Oberman; namely, the general constant of the motion which remains unchanged by the displacement. This is the approach followed here. (M.O.W.)

52153 PARAMETRIC EXCITATION OF NONELECTROSTATIC INSTABILITIES IN A MAGNETOACTIVE PLASMA. Andreev, N. E. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 189-95(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 233-42(Feb 1972).

A magnetized plasma in a high-frequency field is shown to be unstable against nonelectrostatic perturbations over a broad range of field frequencies above the plasma frequency. Expressions are obtained for the growth rates and the threshold of the hf field. Particular low-frequency modes are examined. The conditions are found for which the threshold is substantially smaller (and the growth rate correspondingly greater) than for parametric excitation of electrostatic instabilities. (auth)

52154 DRIFT-DISSIPATIVE INSTABILITY IN A CONFINED PLASMA. Naumovets, V. G.; Pasechnik, L. L.; Popovich, A. S. (Inst. of Nuclear Research, Kiev). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 216-19(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 270-4(Feb 1972).

An experimental study of the low-frequency oscillations of a weakly ionized (10^9 to 10^{10} cm^{-3}) plasma at a gas pressure of 5×10^{-3} to 5×10^{-2} mm Hg in a magnetic field (200 to 2000 Oe) bounded by conducting walls is described. The dependences of the excitation conditions, frequency, and three-dimensional structure of the oscillations on the gas pressure, magnetic field, system length, and the end-electrode potential were investigated. The experimental results are explained within the framework of the theory of drift-dissipative instability and correspond to realization of the maximum growth-rate condition of the linear theory. (auth)

52155 LOW-FREQUENCY INSTABILITY IN A PLASMA WITH ANISOTROPIC ELECTRON TEMPERATURE. Golovanivskii, K. S.; Dugar-Zhabon, V. D. (Patrice Lumumba International Friendship Univ., Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 359-61(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 452-4(Feb 1972).

A brief description is given of an experiment in which a low-frequency instability is observed in a low-pressure discharge excited by a standing microwave near the electron cyclotron-resonance frequency. The discharge is excited in a cylindrical glass tube 30 mm in diameter, which is along the diameter of a cylindrical resonator excited in the E_{010}-wave mode by a 5-W generator ($\lambda = 25$ cm). The tube is filled with mercury vapor at a pressure of 2×10^{-3} torr. The entire system is located in a controlled homogeneous magnetic field. (M.O.W.)

52156 OBSERVATION OF SUPERHEAT INSTABILITY IN A FULLY IONIZED CURRENT-CARRYING PLASMA. Vasil'eva, A. N.; Grishina, I. A.; Pis'mennyi, V. D.; Rakhimov, A. T. (Moscow State Univ). JETP Lett. (USSR) (Engl. Transl.); 15: No. 10, 433-5(20 May 1972).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 15: No. 10, 613-15(20 May 1972).

An experiment to detect superheat instability in a fully ionized current-carrying plasma is described. Current-voltage characteristics of the discharge are described when the current was at a maximum. Photographs of the discharge during development of the instability are given. (M.O.W.)

52157 OBSERVATION OF A HIGH FREQUENCY ELECTROSTATIC WAVE INSTABILITY. Hall, T. A. (European Space Research Inst., Frascati, Italy). Plasma Phys.; 14: No. 7, 677-86(Jul 1972).

Observations are reported on an electron beam-induced instability in a low-pressure discharge contained in a magnetic field at frequencies less than the electron cyclotron frequency. The plasma modes are identified as quasi-electrostatic modes and the strongest excitation mechanism is a resonant interaction with the slow electron beam mode. Measurement of the standing wave pattern shows that the slowest plasma wave observed still has a phase velocity 30% higher than the electron velocity, thus making interaction with the slow beam wave impossible under normal circumstances. It is shown, however, that it is possible for the electron beam to produce an appreciable plasma flow in the opposite direction, resulting in a Doppler shift of the resonant frequency. (auth)

52158 REMOTE FEEDBACK STABILIZATION OF A HIGH-β PLASMA. Chen, Francis F.; Jassby, D. L.; Marhic, M. E. (Univ. of California, Los Angeles). Phys. Fluids; 15: No. 10, 1864-6(Oct 1972).

A current-driven rotational instability in a magnetic arc plasma of density 10^{16} cm^{-3} is suppressed by a totally remote feedback system. Detection is achieved by transmission or reflection of a 337-μ laser beam, with suppression by an oscillating transverse magnetic field. (auth)

52159 NUMERICAL SIMULATION OF THE HARRIS INSTABILITY WITH COLLISIONS. Gitomer, S. J. (Univ. of Pennsylvania, Philadelphia). Phys. Fluids; 15: No. 10, 1861-3(Oct 1972).

The Harris instability in a thermally anisotropic plasma is studied in the presence of electron-electron collisions. The plasma electrostatic field energy decreases and the electron velocity distribution Maxwellization rate increases with increasing collision frequency. (auth)

52160 FINITE LARMOR RADIUS AND HALL EFFECTS ON THERMAL INSTABILITY OF A ROTATING PLASMA. Sharma, R. C. (Univ. of Rajasthan, Jaipur, India). Phys. Fluids; 15: No. 10, 1822-6(Oct 1972).

Thermal instability of a rotating plasma with finite Larmor radius and Hall effects is studied. When the instability sets in as stationary convection for the case of no rotation, finite Larmor radius effects are always stabilizing for $x(= k^2d^2/\pi^2)$ greater than two and for x less than two they have a stabilizing or destabilizing influence depending on whether $N(= \nu_0/\nu)$ is greater than or less than its critical value N_{crit}. In the limit of vanishing Hall current and for stationary convection, the stabilizing effect of the Coriolis force is observed. The conditions for the nonexistence of overstability are investigated. (auth)

52161 NONLINEAR STABILIZATION OF SINGLE, RESONANT, LOSS-CONE FLUTE INSTABILITIES. Crume, E. C. (Oak Ridge National Lab., Tenn.); Meier, H. K.; Eldridge, Owen. Phys. Fluids; 15: No. 10, 1811-21(Oct 1972).

The evolution of linearly unstable, high-frequency ($\omega \approx n\Omega$), flutelike ($k_{||} = 0$), electrostatic modes which can occur in a multicomponent, magnetic-mirror-confined collisionless plasma was studied by computer simulation using a one-and-one-half dimensional model. Approximately one-quarter of the particles in the initial velocity distributions formed a warm, Maxwellian background component; the remainder belonged to a hot, linearly stable, loss-cone component. The early evolution of single wave (either traveling or standing), resonant instabilities agrees well with linear theory. A rapid, coherent heating of the warm component occurs and spatial harmonics of the unstable wave appear. The electrostatic field of the wave then saturates at an energy level as much as two orders of magnitude lower than those reported in previous simulation studies of the same and related instabilities or predicted from earlier nonlinear analysis. The saturation levels and early post-saturation behavior are in agreement with a recently reported nonlinear analysis which was motivated by the results reported here. (auth)

52162 NONLINEAR INSTABILITY OF BERNSTEIN MODES PUMPED BY AN ELECTROMAGNETIC WAVE. Carlile, R. N. (Univ. of Arizona, Tucson). Phys. Fluids; 15: No. 10, 1803-10 (Oct 1972).

The nonlinear decay instability of Bernstein modes pumped by an electromagnetic wave and the subsequent heating of the plasma electrons were investigated by means of computer experiments. It was found that four pairs of Bernstein modes became unstable, and grew to large amplitudes. Each pair, together with the electromagnetic wave, satisfied the criteria for wave–wave interaction. The Bernstein modes would finally saturate. The kinetic energy of the plasma electrons would then begin to increase and, over the time the code was allowed to run, the electrons would have their energy increased by a factor of 4. Saturation occurred when the Coulomb force on a particle due to the electric field of the Bernstein mode became of the order of magnitude of the Lorentz force on that particle due to the magnetic field. The electron probably had its orbital motion destroyed and became trapped briefly in the potential wells of the Bernstein mode. (auth)

52163 CURRENT-DRIVEN DRIFT WAVE INSTABILITY IN A SHEARED MAGNETIC FIELD. Rosenbluth, M. N.; Liu, C. S. (Inst. for Advanced Study, Princeton, N. J.). Phys. Fluids; 15: No. 10, 1801-3(Oct 1972).

In a sheared magnetic field, the eigenfunction of the drift wave is asymmetrized by a current along B_0. Taking into account this asymmetrizing effect, a stability condition for the current-driven drift mode in a sheared field is derived. For magnetic shear generated by the plasma current, a low limit on β_e — the ratio of plasma pressure to magnetic pressure — is required for the stability of a plasma with given density and gradient. (auth)

Thermonuclear Processes

Refer also to abstracts 50330 and 51115.

52164 (AEC-tr-7322) PROJECT FOR ATTAINMENT OF CONTROLLED ATOMIC NUCLEAR FUSION. Nowak, K. Translated from Bull. Schweiz. Elektrotech. Ver.; 63: 337-42(1972). 25p. Dep. NTIS.

The described procedure should permit a technical utilization of controlled atomic nuclear fusion with positive energy balance and a high degree of efficiency. Creation of well-defined conditions should greatly avoid neutron emission and tritium production. To achieve these goals, it is intended to create a short-term impact confrontation between artificial plasmas of high ion density which are formed from previously accelerated deuterium ions and electrons. Proper selection of both impulse time and acceleration should allow the greatest possible efficiency of the fusion process. The assumption that a practically usable controlled nuclear fusion cannot be achieved through confrontation between accelerated atomic ions proved erroneous. The assumption was based on conditions for pure ion beams or usual plasma densities; however, they did not apply to plasma beams of high density. (auth)

52165 (IPP-2/204) PROJECT WENDELSTEIN W VII. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jun 1972. 55p. Dep. NTIS (U. S. Sales Only).

The main parts of the W VII proposal are given. The report is split into two major parts, the first of which is mainly concerned with the scientific aims while the second deals with the technical concept. (M.O.W.)

52166 (JAERI-M-4618) REVIEW ON TOKAMAK EXPERIMENTS. II. Itoh, Satoshi; Fujisawa, Noboru (Japan Atomic Energy Research Inst., Tokyo). Oct 1971. 27p. (In Japanese). NTIS (U. S. Sales Only).

Studies on tokamaks have advanced remarkably, and it is now possible to compare the experiments with theories. The scaling law, obtained with T-3 and TM-3, was confirmed by T-4 and ST, as disclosed at the international conference held at Wisconsin this July. In this report, the latest papers are summarized for the purpose of experiments with JFT-2. (auth) (Japan)

52167 (JAERI-M-4688) IRON CORE OF THE CURRENT TRANSFORMER IN THE MEDIUM-BETA TORUS (JFT-2). Fujisawa, Noboru; Suzuki, Norio; Matsuda, Shinzaburo; Ohga, Tokumichi; Itoh, Satoshi (Japan Atomic Energy Research Inst., Tokyo). Feb 1972. 28p. (In Japanese). NTIS (U. S. Sales Only).

Problems on the iron core of the current transformer in the tokamak-type apparatus, JFT-2, are described. In tokamak-type plasmas, the equilibrium and stability are easily lost due to a weak magnetic field. The stray fields in JFT-2 were studied both experimentally and theoretically. The local saturation in the iron core and the electrical-circuit constants in JFT-2 were also measured and are discussed. (auth) (Japan)

52168 (JAERI-Memo-4084) DESIGN OF MEDIUM-BETA TORUS (JFT-2). Itoh, Satoshi; Takeda, Tatsuoki; Ohta, Mitsuru; Fujisawa, Noboru; Inoue, Kenji; Tanaka, Masatoshi; Maeno, Masaki; Tazima, Teruhiko; Kunieda, Shunsuke (Japan Atomic Energy Research Inst., Tokyo). Jul 1970. (In Japanese and English). NTIS (U. S. Sales Only).

The report discusses the following problems: the current transformer for Joule heating, the toroidal magnet coils, the vertical magnet coils, the vacuum chamber, the shell, the vacuum system, the power supply systems, and the control systems. The plasma diagnostic devices are also described. The principal dimensions of the apparatus as follows: the plasma radius is 30 cm, the major radius is 105 cm, the aspect ratio is 3.5 and the maximum toroidal magnetic field is 20 kG. (auth)

52169 (KHFTI-71-24) STUDY OF THE MAGNETIC SYSTEM OF A STELLARATOR-FUSION REACTOR. Georgievskii, A. V.; Ziser, V. E.; Litvinenko, Yu. A.; Skoblik, M. N.; Suprunenko, V. A.; Tolok, V. T. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 33p. (In Russian). Dep. NTIS (U. S. Sales Only).

The technical possibility of producing a 4.5-GW reactor on the basis of a stellarator is analyzed. Improvement of the stellarator parameters was achieved through the use of a magnet system of the torsatron type and the optimization of its geometric dimensions. The characteristics of the stellarator with optimization of the magnet system are not inferior to the analogous characteristics for reactors with the common toroidal windings of a longitudinal field. An economic comparison of magnet systems with superconductive windings and windings of ultrapure aluminum showed that the capital expenditure for the construction of magnet systems and the cost of electric power developed by the reactor with aluminum coils is about 20% higher as a result of the consumption of energy for the internal needs of the electric power station. (K.S.W.)

52170 (UCRL-51234) DEVELOPMENT AND APPLICATION OF A COUPLED MONTE CARLO NEUTRON-PHOTON TRANSPORT CODE. Robinson, Paul A. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). Jul 1972. Contract W-7405-eng-48. 80p. Dep. NTIS.

A three-dimensional, temperature dependent Monte Carlo photon transport code, HUCK FINN, and a three-dimensional coupled neutron–photon transport code, POGO, were developed and used to study the generation and effect of a photon flux in a controlled thermonuclear reactor (CTR). Potentially inverse Compton scattering, wherein a photon gains energy as a result of scattering from a moving electron within the plasma, provides a mechanism for a photon flux to rob energy from the plasma, thereby affecting the operation of the CTR. Photon fluxes are generated within the CTR by reactions in plasma itself and inelastic neutron events in the blanket surrounding the plasma. The POGO code was used to calculate the photon flux incident on a CTR plasma, and the code HUCK FINN was used to calculate the energy robbed from the plasma via inverse Compton events. These calculations show that photon fluxes generated in the blanket and in the plasma do not significantly affect the operation of currently anticipated CTR's. (auth)

52171 NEUTRON GENERATION IN SPHERICAL IRRADIATION OF A TARGET BY HIGH-POWER LASER RADIATION. Basov, N. G.; Ivanov, Yu. S.; Krokhin, O. N.; (and others). (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 10, 417-19(20 May 1972).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 15: No. 10, 589-92(20 May 1972).

The experimental scheme consisted of focusing nine laser beams on CD_2. Neutron yield measurements were made by three scintillation detectors located at different distances from the target. Data are given for various laser energies. (M.O.W.)

52172 PRECESSION OF A STRONG ASTRON E LAYER. Lovelace, R. V.; Sudan, R. N. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 15: No. 10, 1842-7(Oct 1972).

Precession of weak E layers observed in the astron is compatible with the "superparticle" model according to which the electrons of the layer move as a rigid body at the precession rate of a single electron in the external magnetic fields. The superparticle assumption is investigated by perturbation of a Vlasov equilibrium E layer of arbitrary strength. A slow precessional motion of the layer is found with a frequency equal to the single electron external field precession rate in the weak E-layer limit. For strong E layers with loading factors $\zeta \sim 1$, the precession frequency is reduced from the external field rate, due to the self-field of the layer, by an appreciable factor of the order of $1 + (R/2a)\zeta$, where R is the radius and a is the thickness of the layer. It is shown that there may be damping of the E-layer motion arising from the distribution in energy and/or momentum of the electrons. (auth)

Wave Phenomena

Refer also to abstract 51483.

52173 (AD-735146) RADAR REFLECTION COEFFICIENTS FROM A PLASMA GRADIENT INCLUDING THE EFFECTS OF ELECTRON-NEUTRAL AND ELECTRON-ION COLLISIONS. Redmond, P. J. (General Research Corp., Santa Barbara, Calif.). Sep 1971. Contract DASA01-70-C-0121. 23p. (GRC-RM-1545; DNA-2786-T). NTIS.

An analytical expression is obtained for the radar reflection coefficient from a one-dimensional plasma. The formulation includes the effects of electron-neutral and electron-ion collisions and is applicable for either an exponential variation of the electron density with position or a variation of the form $(n_e)(x) = (n_\infty)/(1 + e^{(-x/d)})$. (auth) (NTIS)

52174 (EUR-CEA-FC-633) NONLINEAR HARMONIC GENERATION AT THE UPPER HYBRID FREQUENCY IN THE ST TOKOMAK. Cano, R.; Etievant, C.; Fidone, I. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1972. 27p. Dep. NTIS (U. S. Sales Only).

The amplitude of the second harmonic excited in the ST Tokamak by an external electromagnetic wave, at the upper hybrid resonance, was estimated. The behavior of the M^2 cross section (intervening in the Poynting vector of the harmonic) as a function of B_t provides a good check of the theory of harmonic generation at the upper hybrid frequency. Unambiguous conditions for the maximum density are given for which a defined resonant peak can be observed. (France)

52175 (IPP-2/203) EFFECT OF RATIONAL TRANSFORM ON THE OHMICALLY HEATED PLASMA IN THE WIIb STELLARATOR. Grieger, G.; Hugill, J.; Jaenicke, R.; Juulman, C. O. L.; Mahn, C.; Renner, H.; Ringler, H.; Schilling, G.; Wolf, G. H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). May 1972. 16p. Dep. NTIS (U. S. Sales Only).

Minima in the rate of growth of current accompanied by oscillations were observed in the $l = 2$ ohmically heated W IIb stellarator. By varying the rotational transform of the vacuum field it could be shown that these are related to rotational transform near the plasma boundary. (auth)

52176 (IPPJ-114) RADIAL PROPAGATION OF DRIFT WAVE IN FINITE LENGTH PLASMA. Uramoto, Johshin (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1971. 19p. NTIS (U. S. Sales Only).

Radial propagations of a drift wave excited near a plasma column in a uniform magnetic field B are investigated under two metal or insulator end plates. For the insulator ends, the drift wave propagates across B (radially), while, for the metal ends, it damps abruptly. These results are explained by the short effect of the ends on the wave potential and an enhanced diffusion. (auth) (Japan)

52177 (IPPJ-116) ASYMPTOTIC METHOD FOR THE VLASOV EQUATION. III. TRANSITION FROM AMPLITUDE OSCILLATION TO LINEAR LANDAU DAMPING. Sugihara, Ryo; Kamimura, Tetsuo (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1972. 39p. NTIS (U. S. Sales Only).

A numerical investigation of the nonlinear behavior of Landau damping is achieved. The basic equations cover the amplitude oscillation, the linear Landau damping, and intermediate regions on wave behaviors. One finds that a plateau is formed in a temporal profile of amplitude of an electric field D for $q \ll 1$, but also for $q \lesssim 0.5$ the plateau seems to be constructed, where $q \equiv \gamma_L/\omega_B$, γ_L being the linear Landau damping coefficient and ω_B the bouncing frequency of trapped electrons in a potential trough of a wave. Another kind of plateau appears for $q \approx 0.77$ and for $q < 0.77$ the wave damps out (not necessarily Landau damped). Time evolution of the number of "trapped" electrons and of distributions of resonant electrons is shown. It is found that even if D is almost saturated when $q \ll 1$ the corresponding distribution is not necessarily seen to be flat. (auth) (Japan)

52178 (IPPJ-118) NONLINEAR MAGNETOSONIC WAVES IN A TURBULENT PLASMA. Sakai, Jun-ichi (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1972. 20p. NTIS (U. S. Sales Only).

Nonlinear magnetosonic waves in a turbulent plasma, characterized by an effective electric conductivity due to microinstabilities, are governed by the Burgers-type equation, which has a shock-like stationary solution. It is shown that initial magnetic pulses of gaussian and solitary wave forms first decay due to dissipation, and subsequently form a shock front whose steepness is determined by the opposing effects of nonlinearity and dissipation. This process is thought to be important in connection with shock formation in space plasmas. (auth) (Japan)

52179 (IPPJ-119) OBSERVATION OF STABLE, HIGH-MACH-NUMBER COLLISIONLESS ELECTROSTATIC SHOCKS. Honzawa, Tadao (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1972. 18p. NTIS (U. S. Sales Only).

Observation of large-amplitude ion-acoustic shocks with a high Mach number $M > 1.6$ in a collisionless plasma characterized by $T_e/T_i \simeq 10$ is described. Although they have large fluctuations behind the front, these shocks are close to the laminar rather than the turbulent ones, and they behave nonstationarily during propagation. Discussions about the nature and behavior of the shock are also given. (auth) (Japan)

52180 (JAERI-M-4640) STUDIES ON A ROTATION IN THE POLARIZATION OF AN ELECTROMAGNETIC WAVE PROPAGATING IN A MAGNETIZED PLASMA. Funahashi, Akimasa; Tazima, Teruhiko (Japan Atomic Energy Research Inst., Tokyo). Nov 1971. 19p. (In Japanese). NTIS (U. S. Sales Only).

Polarization of the electromagnetic waves that propagate in a magnetized plasma obliquely to the magnetic field is studied. A general expression is derived for a rotation in the wave polarization when the longitudinal component of wave field (in the direction of wave propagation) is much less than the transverse component. Equations of the rotation are then obtained in the regions where no studies so far have been made. In addition, the 2-mm waves in JFT-2, a tokamak-type apparatus, are also examined preliminarily to obtain information on the current distributions. (auth) (Japan)

52181 INFLUENCE OF ELECTRON AND ION PRESSURE NEAR THE LOWER HYBRID RESONANCE. Babu, R.; Lammers, B.; Schlueter, H. (Ruhr Univ., Bochum, Ger.). Z. Naturforsch.; 27a: No. 6, 930-8(Jun 1972).

Near the lower hybrid resonance the power transfer from electromagnetic waves to a plasma cylinder is calculated with the inclusion of electron and ion pressures. Ion-electron collisions are accounted for, in addition to the collisions of charged particles with neutrals. Drastic deviations from calculations neglecting the pressure effects occur for plasmas of low electron density and/or small radial extent. Different ranges of a specific ratio comparing the influence of collision with that of pressure terms are investigated. (auth)

52182 DIFFRACTION OF PLANE WAVES ON AN IMPEDANCE WEDGE IN AN ANISOTROPIC PLASMA. Bobrovnikov, M. S.; Fisanov, V. V. (Siberian Physical-Technical Inst., Tomsk, USSR. Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 80-6(1972). (In Russian).

An ionic layer is formed on the surface of a conducting object in the ionosphere. Boundary conditions of an impedance type are introduced to allow for this phenomenon. Field analysis of a special case of the general problem was conducted on the basis of the results previously obtained by one of the authors. (K.S.W.)

52183 DISPERSION OF CYCLOTRON WAVES IN A PLASMA. Kaladze, T. D.; Lominadze, D. G.; Stepanov, K. N. (Tbilisi State Univ., USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 196-202(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 243-52(Feb 1972).

A numerical solution of the dispersion equation is given for electron and ion cyclotron waves propagating perpendicular to a magnetic field in a plasma with finite β, where β is the ratio of the plasma pressure to the magnetic pressure. (auth)

52184 EFFECT OF A TIME-VARYING MAGNETIC FIELD ON ION-ACOUSTIC WAVES IN A MAGNETIZED PLASMA. Kostyukova, Yu. S.; Nekrasov, F. M. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 210-15(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 262-9(Feb 1972).

The stability of a collision-free inhomogeneous magnetized plasma is studied in a high-frequency field. The electric component of the hf field [$E_z(x,t) = E_0(x) \sin \Omega_0 t$] is parallel to the constant magnetic field H_0, while the magnetic component [$H_y = -h_0(x) \cos \Omega_0 t$] is perpendicular to it and the inhomogeneity gradient. In the frequency region Ω_0, $\Omega \ll k_z v_{Te}$ (Ω_0 and ω are the frequencies of the hf field and the perturbations, respectively) the time-varying magnetic field has no influence on the growth rates for electrostatic ion-acoustic waves ($n_i \simeq n_e$, $k^2\lambda_{De}^2 \ll 1$). The inequality $(k_y/k_z)(h_0/H_0) < 1$ is assumed to be satisfied in this case. In the shortwave region ($k^2\lambda_{De}^2 \sim 1$), the time-varying magnetic field can lead to parametric excitation of ion-acoustic oscillations. The growth rate, instability zone, and critical amplitude of the varying magnetic field for these oscillations are determined in the first instability zone, $\Omega_0/2 = \omega_s^2/(1 + k^2\lambda_{De}^2)$. The analogous parameters are found for the second instability zone ($\Omega_0 = \omega_s$) of long-wave ion-acoustic oscillations, where it is important to take into account both components of the hf field (magnetic and electric). Consideration is given to the nonresonance instability of the ion-acoustic oscillations excited by the constant component of an electron flow perpendicular to the constant magnetic field. This flow is excited in the plasma when the hf field is applied. The parametric excitation of plasma oscillations by the time-varying magnetic field in the first instability zone is discussed. (auth)

52185 ABSORPTION OF THE EXTRAORDINARY WAVE IN A BOUNDED MAGNETOACTIVE PLASMA. Bogomolov, Yu. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 2, 224-5(Aug 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 2, 280-1(Feb 1972).

The absorption of an electromagnetic wave in a bounded magnetoactive plasma is calculated for specular and diffuse reflection of electrons at the plasma boundary. The magnetic field is parallel to the boundary and the electric vector of the incident wave lies in the plane of incidence. The electron thermal motion is assumed weak. It is shown that, for normal incidence of the wave, the absorption coefficients for specular and diffuse boundaries are of the same order of magnitude. An exception is the case of low frequencies. Oblique incidence is considered in this limiting case, in which the absorption for the specular boundary proves to be much smaller than for the diffuse boundary. (auth)

52186 MEASUREMENTS OF ENHANCED ABSORPTION OF ELECTROMAGNETIC WAVES AND EFFECTIVE COLLISION FREQUENCY DUE TO PARAMETRIC DECAY INSTABILITY. Chu, T. K.; Hendel, H. W. (Princeton Univ., N. J.). Phys. Rev. Lett.; 29: No. 10, 634-8(4 Sep 1972).

Enhanced absorption of an electromagnetic wave near ω_{pe} was observed coincident with the onset of parametric decay instability in a Q-device plasma. The effective collision frequency $\nu_{eff} = \nu_{ei}(E/E_c)^2$. (auth)

52187 PLASMA INVERSE PROBLEM. Balanis, George Nick (Applied Theory, Inc., Westwood, Calif. California Inst. of Tech., Pasadena). J. Math. Phys. (N. Y.); 13: No. 7, 1001-5(Jul 1972).

A simple and direct development of the theory of the plasma inverse problem is given, and it is shown that the time record of the reflected wave arising from a δ function electric field normally incident on a stratified plasma determines uniquely the plasma density through an integral equation. (auth)

52188 BOUNDS FOR SOLUTION OF NONLINEAR WAVE–WAVE INTERACTING SYSTEMS WITH WELL-DEFINED PHASE DESCRIPTION. Wang, P. K. C. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.); 13: No. 7, 943-7(Jul 1972).

Upper and lower bounds for the solutions of nonlinear three-wave interacting systems with well-defined phase description are established. The results are used to deduce a sufficient condition for the nonexistence of explosive instabilities. (auth)

52189 EXCITATION OF VOLUME ION-ACOUSTIC OSCILLATION IN AN INHOMOGENEOUS DENSE PLASMA BY THE FIELD OF AN ELECTROMAGNETIC WAVE. Aliev, Yu. M.; Gradov, O. M.; Kirii, A. Yu. (Inst. of Physics, Lebedev, USSR). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 493-5(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 694-6(5 Jun 1972).

The theory of nonlinear interaction between a strong electromagnetic wave and an opaque plasma is studied. Equations are given for the frequency of the quasi-static surface oscillations and the damping decrement. The case of normal incidence of the electromagnetic wave on the plasma layer is considered. The interaction between the surface wave and field causes growth of the ion-acoustic oscillations in the entire volume of the plasma. The growth increment of the oscillations is estimated. (D.L.C.)

52190 TIME-OF FLIGHT STUDIES OF PROPAGATING ELECTROSTATIC LONGITUDINAL WAVES IN A HOMOGENEOUS PLASMA. Treguier, J. P.; Henry, D. (Centre National d'Etudes des Telecommunications, Lannion, France). Plasma Phys.; 14: No. 7, 667-75(Jul 1972).

An experimental measurement of the time-of-flight of a high-frequency electrostatic longitudinal sine wave burst through a hot, homogeneous, and isotropic plasma is described. The group velocity of the pulse for frequencies higher than 1.2 times the plasma frequency (fp) was measured. For frequencies between fp and 1.2 fp (in this range the plasma is a high dispersive medium), and for small distances of propagation, up to 2 wavelengths, it was observed that the pulse maximum travels with a velocity lower than the group velocity, in good agreement with numerical calculation. For larger distances of propagation, the sine wave burst splits into 2 pulses: the first pulse is due to the propagation of electron-ballistic waves, while the second one is characteristic of the principal Landau poles. (auth)

52191 NONLINEAR COLLISIONAL EXCITATION OF PLASMA WAVES. Stenflo, L. (Inst. of Physics, Umeaa, Sweden). Plasma Phys.; 14: No. 7, 713-16(Jul 1972).

The interaction between two electromagnetic waves in a current-carrying electron plasma was studied. It is shown that nonlinearities in the collision term may be responsible for the excitation of longitudinal plasma waves. (auth)

52192 PROPAGATION OF NON-AXISYMMETRIC ALFVEN WAVES IN AN ARGON PLASMA. Lehane, J. A.; Paoloni, F. J. (Univ. of Sydney). Plasma Phys.; 14: No. 7, 701-11(Jul 1972).

The propagation of nonaxisymmetric waves in a uniform, cylindrical argon plasma was investigated; the frequency range and the plasma conditions were chosen so that both the slow and the fast waves were observed. Measurements dealt mainly with the dispersion relations and the radial variations of the wave fields which compared with predictions from magnetohydrodynamic theory assuming that the boundary condition to be applied was that for an infinitely conducting boundary, viz., that the radial magnetic field becomes zero at the plasma boundary. The propagation of the $m = -1$ slow wave and the $m = +1$ fast wave was consistent with theory but there was a discrepancy for the $m = +1$ slow wave. The $m = -1$ fast wave was not observed to propagate. (auth)

52193 HIGH-FREQUENCY MAGNETIC WAVES IN A WEAKLY IONIZED PLASMA. Cristea, M. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 1, 59-63(1972). (In Rumanian).

Dispersion equations for high frequency waves in a weakly ionized plasma were developed for crossed fields. An approximate solution for the given equation indicated that in this region of frequencies, a magnetoactive plasma is stable. (tr-auth)

52194 EXCITATION OF PLASMA WAVES BY TWO LASER BEAMS. Rosenbluth, M. N.; Liu, C. S. (Inst. for Advanced Study and Plasma Physics Lab., Princeton, N. J.). Phys. Rev. Lett.; 29: No. 11, 701-5(11 Sep 1972).

The effects of the nonlinearity of the large-amplitude plasma wave and the inhomogeneity of the plasma on the excitation of the plasma wave were investigated during beating of two laser beams. (auth)

52195 DE-TRAPPING OF TRAPPED PARTICLES BY A SECOND WAVE. Sakai, J.; Kamimura, T. (Nagoya Univ., Japan). Phys. Lett.; 41A: No. 1, 75-6(28 Aug 1972).

Detrapping of particles, originally trapped in the first whistler wave by a second whistler wave, is investigated both analytically and numerically. (auth)

52196 EFFECT OF SHEAR ON TEMPORAL DAMPING AND GROWTH OF DRIFT WAVES. Nishida, Y.; Odajima, K.; Hatta, Y. (Tohoku Univ., Sendai). Phys. Fluids; 15: No. 10, 1859-61(Oct 1972).

The effects of magnetic shear on the damping and growth rates of collisionless drift waves are observed in a linear stellarator with $l = 3$ helical windings. Increasing the magnetic shear reduces the temporal growth rate and increases the damping rate of drift waves. (auth)

52197 GENERATION OF PLASMA OSCILLATION BY BEAM–PLASMA INTERACTION. Khan, T. P. (Dinabandhu Andrews Coll., Garia, India). Phys. Fluids; 15: No. 10, 1857-9(Oct 1972).

The frequencies of the electrostatic plasma oscillation have an angular dependence similar to that in the normal Doppler effect, the anomalous Doppler effect, and the Cherenkov effect. Light emission at the different stages of the electromagnetic interactions were also studied. (auth)

52198 COMPUTER SIMULATION OF DATTNER-MODE PROPAGATION IN A PLASMA. Swinford, Harold Wade. Tucson, Ariz.; Univ. of Arizona (1972). 81p. University Microfilms Order No. 72-21,436.

Thesis.

Current models used to study wave propagation in bounded plasmas are limited to small-amplitude waves since the equations must be linearized to obtain a solution. The existing models are also limited because they neglect the spread in the thermal velocities of the electrons in the plasma. It is the objective of this work to develop a model which is equally valid in the small-amplitude regime and in the large-amplitude or nonlinear regime. This model also includes the spread in thermal velocities of the electrons. The new model presented is a computer simulation model in which a digital computer is used to follow the motion of a statistical sampling of the electrons in the plasma. The cold plasma model and the warm plasma model are derived from basic transport theory. The assumptions necessary to obtain these models are discussed. The cold plasma model and the warm plasma model are applied to the problem of small amplitude wave propagation in a two-dimensional plasma in rectangular coordinates. The results of the two solutions are contrasted. The assumptions necessary to obtain these solutions are presented with respect to the range of validity of the solutions. The general concept of computer simulation is then discussed. Special emphasis is placed on the numerical techniques which are used to implement the solution on a digital computer. Three criteria necessary for a valid plasma simulation are presented. The computer simulation model for waves in a bounded plasma is presented. The boundary conditions on the sample electrons and on the electric potential are discussed. The economic advantages in limiting the computer simulation to symmetric wave modes is shown. Obtaining data on the dispersive properties of the modes propagating in the computer simulation plasma is made difficult due to the presence of the thermal and shot noise inherent in the computer simulation model. A simple model for the temporal behavior of a wavevector is proposed. This simple model is used to demonstrate how time autocorrelation of a wavevector facilitates the determination of the frequency associated with a given wavevector. The computer simulation model is applied to the study of the natural modes of the bounded, two-dimensional plasma. Dispersive data are obtained for the surface wave mode and the two lowest order Dattner modes. The results are found to be in good agreement with the warm plasma model. The variation of the electric potential in the direction transverse to the direction of wave propagation is compared with the predictions of the warm plasma model with good qualitative agreement between the two models. The plasma simulation model is extended to the inhomogeneous plasma. The results obtained from the computer simulation clearly demonstrate the validity of a computer simulation model for investigations of waves in a plasma. (Diss. Abstr. Int., B)

52199 EFFECT OF A SHEATH AND SURFACE IRREGULARITIES ON THE SCATTERING CROSS SECTION IN A COMPRESSIBLE PLASMA. Oh, Myung. Stony Brook, N. Y.; State Univ. of New York (1972). 110p. University Microfilms Order No. 72-22,864.

Thesis.

The effects due to a sheath and the surface irregularities on the scattering cross section of an infinite conducting cylinder immersed in a compressible plasma medium are investigated by using the boundary-perturbation method. The total scattering cross section and the backscattering cross section are obtained for the cases of both the incident electromagnetic wave and the incident plasma wave. The work is divided into three parts: the effects of surface irregularities, the effect of a sheath, and the combined effect of surface irregularities and a sheath. Numerical examples are given for the case when the radius of the scattering cylinder is not too large compared to the wavelength of the incident electromagnetic wave. Results for the total scattering cross section and the backscattering cross section are presented in graphs together with discussions. (Diss. Abstr. Int., B)

52200 TRANSIENT WAVE PROPAGATION IN AN ANISOTROPIC WARM PLASMA. Soong, An-Hwa. New York; New York Univ. (1971). 97p. University Microfilms Order No. 72-21,790. Thesis.

The transient-wave field response excited by a line source is formulated for an anisotropic warm unbounded plasma. The response is given in the form of a four-dimensional inverse Fourier transform whose integrand consists of the product of the steady-state dyadic Green's function and the transform of the excitation. The response is expressed as a convolution integral. A method to perform the indicated integration is derived using the saddle-point technique. In particular, a one-component anisotropic warm plasma is investigated in detail. Using computer programming techniques, a systematic approach is presented to quantitatively investigate the transient field responses to a line source of a switch-on sinusoidal signal. Relationships are shown among the dispersion relation depicted in wave vector diagrams, saddle point movement as a function of time and the influence of input frequency on the signal arrival time. Magnitude of the transient electric field response is compared for different input signal frequency and observation distance. (Diss. Abstr. Int., B)

52201 WAVE GROWTH IN A STRONGLY TURBULENT PLASMA. Birmingham, T. J. (Goddard Space Flight Center, Greenbelt, Md.); Bornatici, M. Phys. Fluids; 15: No. 10, 1785-9(Oct 1972).

An equation for the average nonlinear growth (damping) rate $\langle\gamma_k\rangle$ of an electrostatic mode with wave vector k for an ensemble of electrostatically turbulent, unmagnetized plasmas is derived. Strong turbulence alters particle orbits during the course of wave growth and hence brings particles in and out of resonance with the wave. The wave-growth rate in a strongly turbulent plasma, therefore, depends on the initial velocity distribution of particles not only at $u = \hat{k}\cdot v = \alpha_k/k$, the wave speed, but in the vicinity of this speed as well. Two orbital effects are considered: turbulence modification of ensemble average orbits and turbulence-produced orbital dispersion about the average orbits. The first of these leads to a shift in the central u of the resonance. Both contribute to a resonance broadening. (auth)

52202 MICROWAVE SCATTERING FROM UNDERDENSE AND OVERDENSE TURBULENT PLASMAS. Attwood, David Thomas Jr. New York; New York Univ. (1972). 172p. University Microfilms Order No. 72-21,758.

Thesis.

Experimental results of microwave scattering from a turbulent plasma are presented and compared with pertinent theories. For underdense values of mean and fluctuation electron density, scattering is similar to that noted by several other groups, following Born predictions for very weak scattering and saturating as the critical point is approached. Near the critical point for average electron density, a crossover from volume to surface scattering is observed. For sufficiently overdense values, scattering resembles that from a reflecting surface of appropriate shape and statistics, mean density distribution notwithstanding. Scattering in this latter regime is used as a diagnostic tool to determine the probability distribution function for orientation fluctuations displayed by the overdense thrashing plasma column. (Diss. Abstr. Int., B)

52203 SELF-CONSISTENT ELECTROMAGNETIC WAVES IN RELATIVISTIC VLASOV PLASMAS. Winkles, B. B. (Univ. of Tennessee, Knoxville); Eldridge, Owen. Phys. Fluids; 15: No. 10, 1790-1800(Oct 1972).

It is shown that the treatment of relativistic superluminous waves can be simplified by making a Lorentz transformation to a new frame in which the spatial variable no longer appears. Self-consistent solutions of the relativistic Vlasov–Maxwell equations can be constructed in the new frame. These solutions correspond to nonlinear traveling waves in a finite temperature plasma, and reduce to the usual linear results in the small-amplitude limit. A particular example is considered in which the nonlinear waves propagate through a relativistic Maxwellian plasma, and it is shown that pure transverse waves cannot exist in such a case, but that a coupled longitudinal field necessarily appears. For this case the nonlinear effects are evaluated correct to second order in the transverse field amplitude, thus obtaining a nonlinear dispersion relation and a measure of the coupling. In addition, solutions involving pure longitudinal waves can be found, and are also investigated. In limiting cases the results agree closely with previous calculations based on hydrodynamic models. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 50673, 50677, 50744, 50802, 50816, 50920, 51525, and 52170.

52204 (AEC-tr-7138, pp 148-59) NOMOGRAMS FOR PLOTTING ISODOSE CHARTS IN REMOTE GAMMA-THERAPY. Galina, L. S. Translated from Radiats. Tekh.; No. 3, (1969).

Isodose charts for a limited number of field sizes and source-to-surface distances (SSD's) can be used to plot nomograms for tracing the dose distribution for any selected dose field and SSD. The nomograms describe the relation between the isodose curves and the beam axis as a function of the dimensions of the edge of a square field in cross sections parallel to the surface of the irradiated medium for fixed SSD at various depths. It is assumed that the radiation beam is incident on a plane surface. For different irradiation conditions (nonsquare field, different values of SSD) it is possible to introduce corrections that take into account the effect of those factors on the dose distribution. Nomograms for plotting isodose charts for the Soviet ''Luch'' and ''Rad'' gamma-therapy equipment operating under static irradiation conditions are presented. (6 figures, 2 tables) (R.W.R.)

52205 (ANL-7860(Pt.1)) RADIOLOGICAL PHYSICS DIVISION ANNUAL REPORT, JULY 1970-JUNE 1971. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 60p. Dep. NTIS.

In addition to studies on photoabsorption and photoionization of gaseous molecules, luminescence of aromatic molecules in liquids, and theoretical studies, a new program on electron scattering was initiated; the program on radiation dosimetry was discontinued. Information is reported in thirteen sections, some of which was given at conferences or published elsewhere. A separate abstract was prepared for each of four sections containing unpublished information and in scope for NSA. (L.M.T.)

For abstracts of individual sections see: 50635, 50636, 51501, and 52206.

52206 (ANL-7860(Pt.1), pp 16-27) ELECTRON ENERGY-LOSS SPECTRUM OF ACETONE: PRELIMINARY REPORT. Huebner, R. H.; Lindner, D. L.; Mielczarek, S. R.; Kuyatt, C. E. (National Bureau of Standards, Washington, D. C.). 1971.

In Radiological Physics Division annual report, July 1970-June 1971.

The electron energy-loss spectrum of acetone vapor from 0 to 12 eV for 100-eV incident electrons at 0° scattering angle is presented and discussed. Observed valence transition energies agree closely with optical values. A new Rydberg series is discovered. The differential oscillator-strength distribution derived from the energy-loss data agrees very well with optically determined values for the ionization continuum. (auth)

52207 (BNWL-1651(Pt.2), pp 99-106) RADIATION DOSIMETRY. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

These studies are primarily concerned with the stochastic nature of absorbed dose. The objective is to determine those features of energy deposition patterns that are relevant to the understanding of observed biological effects. Theoretical effort is in development of mathematical models and computational techniques to couple the spatial distribution of energy deposition with temporal distributions. Emphasis is on understanding time-dependent effects and dose rate dependence of the oxygen effect. Experimental work is in the application of cross section measurements to the problem of energy transport by δ rays and to a more detailed description of proton stopping powers. (auth)

52208 (BNWL-1651(Pt.2), pp 107-11) RADIATION PHYSICS. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972.

In Annual report for 1971 to the USAEC Division of Biology and Medicine. Volume II. Part 2.

Emphasis is on biologically relevant materials. The studies involve the initial interactions by which ionizing particles transfer energy to matter and the subsequent transport and degradation of that energy. The work includes experimental measurement of the doubly differential cross sections for electron ejection by monoenergetic protons, investigation of the partition and distribution of energy in the radiation field and in the irradiated medium, and determination of the rates and mechanism for energy transfer in the early stages of molecular rearrangement. (auth)

52209 (EGG-1183-1547) ENERGY RESPONSE OF X-RAY REFLECTING SURFACES. Technical Report No. 1061. Brown, Robert T. (EG and G, Inc., Las Vegas, Nev.). Jun 1972. Contract AT(29-1)-1183. 38p. Dep. NTIS.

Reflectivity as a function of energy was calculated for x rays incident at small angles on metallic Be, BeO, and pyrolytic graphite. The glancing angles used range from 3 mrad to 40 mrad, resulting in cutoff energies ranging from 0.65 keV to 11.55 keV. The calculation takes into account the fact that absorption leads to a complex index of refraction as well as the effect of absorption edges on the real part of the index of refraction. (auth)

52210 (EUR-4786) MASS STOPPING POWER AND PATH-LENGTH OF NEUTRON PRODUCED RECOILS IN TISSUE AND TISSUE EQUIVALENT MATERIALS. I. NEUTRON ENERGY ≤ 6 MeV. Oldenburg, U.; Booz, J. (European Communities, Brussels (Belgium). Commission. European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar 1972. 134p. Dep. NTIS (U. S. Sales Only). EUR B.Fr.175.-.

Nuclear and electronic mass stopping powers and ranges of 8 neutron-produced recoil ions in 5 different tissue-like absorbers are calculated using the theories of Bethe, Bloch, and Lindhard and Scharff and Schiott. In between the two theories an interpolation within available experimental values has been made. The maximum energy of the ions that is dealt with corresponds to a neutron energy of 6 MeV. The results are presented in 120 tables. The 8 recoil ions are protons, deuterons, alpha particles, ^{12}C, ^{14}N, ^{16}O, ^{19}F, and ^{32}S. Their mass stopping powers and ranges are given in wet tissue (ICRU), tissue equivalent gas 1 (ROSSI, FAILLA), tissue equivalent conducting plastic (SHONKA), tissue-equivalent gas 2 (SRDOC), and water, and in the single elements contained in the different absorbers (H, C, N, O, F, Si, P, S, K, Ca). (auth)

52211 (EUR-4810(Vol.1), pp 31-69) STATUS OF THE THEORY OF DELTA-RAY PRODUCTION. Turner, James E.; Klots, Cornelius E. (Oak Ridge National Lab., Tenn.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Methods for calculating delta-ray spectra produced by heavy ions and electrons are reviewed. Their basic assumptions are characterized and their validity assessed by comparison with experiment. An appraisal of the extent of knowledge, both theoretical and experimental, is made. The ways in which this information might be used to examine the foundations of microdosimetry are discussed. (54 references) (auth)

52212 (EUR-4810(Vol.1), pp 71-94) ENERGY EJECTED IN FAST PROTON COLLISIONS. Glass, W. A.; Toburen, L. H.; Wilson, W. E.; Roesch, W. C. (Battelle-Northwest, Richland, Wash.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

An analysis of the relative importance of various processes by which the energy of fast protons is transferred to a medium of low atomic number shows that, in the proton energy range 300 to 1700 keV, about 50 to 60% appears as kinetic energy of the secondary electrons and 25 to 30% is involved in overcoming the binding energy of these electrons. The remaining 10 to 20 percent can be accounted for as primary excitation, recoil, etc. Distributions in angle and in the kinetic energy associated with electrons ejected by protons in passing through various gas absorbers are presented; they were derived from experimentally measured cross sections. Effects of chemical binding energy on electron ejection cross sections are considered. Energy distributions of secondary electrons are compared with results obtained using a binary encounter theory to illustrate the degree of applicability of this semiclassical treatment. The importance of secondary electrons for energy deposition in small sites is considered. (auth)

52213 (EUR-4810(Vol.1), pp 95-107) ENERGY AND ANGULAR DISTRIBUTION OF DELTA ELECTRONS EJECTED FROM GAS MOLECULES IONIZED BY PROTONS. Stolterfoht, N.; Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The cross-beam method was used to measure absolute double differential cross sections for the ejection of electrons from gas molecules bombarded by 200- to 500-keV protons. The secondary electrons with energies down to 1 eV were analyzed with a resolution of 1.1% by means of an electrostatic parallel-plate spectrometer movable in the angular range of 20 to 155° with respect to the incident proton beam. The measured cross sections were integrated to obtain single differential and total ionization cross sections. The electron spectra using methane and nitrogen as gas targets indicate a strong decrease with increasing electron energy. The single differential cross sections as a function of the sum W of the electron energy and the first ionization potential are proportional to W^{-c} within a large range with $c = 2.3$. (auth)

52214 (EUR-4810(Vol.1), pp 109-26) SPATIAL DISTRIBUTION OF IONIZATION AND DEPOSITED ENERGY ALONG PROTON TRACKS IN GASES. Jacobi, W.; Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

On the basis of measurements of the double-differential ionization cross section of 0.2- to 0.5-MeV protons in helium, nitrogen, and methane the following quantities are evaluated and discussed: (1) the relative energy loss of protons due to excitation and ionization and the energy transferred to secondary electrons; (2) the ionization yield of secondary electrons and the frequency of ion clusters; (3) the average energy expended per primary ion pair; (4) the radial dose distribution around the proton track due to secondary electrons; and (5) the energy- and distance-restricted linear energy transfer (LET) of protons in gases. (auth)

52215 (EUR-4810(Vol.1), pp 127-39) ENERGY DISTRIBUTION OF ION PRODUCED DELTA ELECTRONS. Booz, J. (EURATOM, Ispra, Italy).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The linear ion density of ions is used as an additional test criterion for energy distribution functions of their delta rays. Preliminary results on the energy distribution of delta rays are given for protons. The dependence of the results on the value W of low-energy electrons is discussed. (auth)

52216 (EUR-4810(Vol.1), pp 141-55) CHARGED PARTICLE TRACK STRUCTURE IN SOLIDS AND GASES. Paretzke, H. G. (Gesellschaft fuer Strahlen- und Umweltforschung, Munich).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The physical track of a charged particle is determined by the local distribution of localized events around the ion path at the end of the physical interaction phase. This distribution represents the initial state for the subsequential chemical, biochemical, or biological processes and, therefore, strongly influences the final effect of the radiation. Studies of track structure in condensed matter are experimentally extremely difficult and therefore mostly based on theoretical models. Lacking appropriate information for solids, these models mainly use experimental and theoretical input data for gaseous targets, i.e., for independent and simple particle interaction. Some problems, which arise from extrapolation of gaseous to solid state conditions, are discussed and their influence on simulation calculations shown. There exists strong evidence that the present σ-ray model does not agree in principle with radiation chemical knowledge. At present it seems to be a thorny way for microdosimetry to go down to track structure in order to approach a better understanding of radiation quality on the molecular level. (37 references) (auth)

52217 (EUR-4810(Vol.1), pp 157-77) ENERGY DEPOSITION BY LOW-ENERGY ELECTRONS: DELTA-RAY EFFECTS IN TRACK STRUCTURE, AND MICRODOSIMETRIC EVENT-SIZE SPECTRA. Berger, M. J. (National Bureau of Standards, Washington, D. C.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The slowing down, diffusion, and penetration of low-energy electrons were calculated by the Monte Carlo method, in order to obtain data of radiobiological interest in two areas. One calculation deals with the energy deposited by delta rays around the tracks of heavy charged particles. Absorbed-dose distributions with respect to distance from the primary track axis were obtained for six initial electron energies (20, 10, 5, 2, 1, and 0.5 keV) and for ten emission angles with respect to the primary track (0, 10, . . . 90°). These data were put in such a form that interpolation with respect to initial delta-ray energy and emission angle is easy. They can be used together with experimental or theoretical information about delta-ray production to study track structure for any heavy charged particle. The second problem is to determine microdosimetric event-size spectra in a medium containing a uniform concentration of the beta-emitter tritium. Comparisons are made with experimental results of Ellett and Braby for spherical sites, with diameters of 1.85 and 0.44 microns, in a propane medium. (auth)

52218 (EUR-4810(Vol.1), pp 403-15) FURTHER THOUGHTS ON THE W VALUES FOR HEAVY IONS. Dennis, J. A. (Atomic Energy Research Establishment, Harwell, Eng.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The extensive and consistent set of experimental data by Macdonald and Sidenius (Physics Letters 28A: 543-544 (1969)) on the ionization of methane by heavy ions is examined in the light of calculations of the energy expended in elastic nuclear scattering (Rad. Effects 8: 87-98 (1971)). Although the dependence of W on the ion energy can, to some extent, be explained in terms of the elastic nuclear scattering, a more useful set of empirical relationships based on the ion velocity can be derived. The experimental data clearly demonstrate that W values are a periodic function of the atomic number of the heavy ion. Those atoms with a single electron in the outer shell show increased W values relative to other atoms at the same velocity. The implications of these effects for the mean W values for neutron-irradiated gases are considered briefly. (auth)

52219 (EUR-4810(Vol.1), pp 417-44) EFFECTIVE W(eV/ion pair) FOR NEUTRON PRODUCED IONS IN A TISSUE EQUIVALENT IONIZATION CHAMBER. Leonard, B. E. (Inst. for Resource Management, Inc., Bethesda, Md.).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The effective W_{ion} was required for the distribution of ions produced by neutrons when a tissue-equivalent(TE) chamber is used in reactor neutron fields. Measurements were made of the relative currents in paired carbon and TE plastic-walled ionization chambers vs chamber cavity size in high neutron (N) to gamma-ray (Γ) tissue absorbed dose fields at the AFRRI–TRIGA Reactor ($N/\Gamma \approx 10$) and the ANL–JANUS Reactor ($N/\Gamma \approx 30$) using TE gas, CO_2, and Ar as the ionizing gas. Due to the lower relative energy loss to nonionizing elastic coulomb collisions (ECC) in CO_2 and Ar, an estimate was obtained of the loss by ECC in TE gas from the low-energy ions entering the cavity from the wall of the TE chamber. The data indicate about a 50% loss of energy to ECC for the wall-emitted ions in the TE gas. (auth)

52220 (EUR-4810(Vol.1), pp 445-54) NUCLEAR STOPPING OF ENERGETIC IONS. Loester, W.; Grassl, P.; Burger, G. (GSF-Institut fuer Strahlenschutz, Nuremberg).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

At lower energies, the nuclear interaction becomes more important. The scattering of protons at energies of 0.5 keV and above on several gases was studied experimentally. The measured differential cross sections for protons on hydrogen show that the experimental potential is closer to the Coulomb than to the Thomas–Fermi potential. The nuclear stopping power is shown in generalized coordinates. Monte Carlo calculations were performed for the slowing down of a 1-keV proton in water. The resulting histogram shows that more than 90% of the collisions will lead to no displacements. The average kinetic energy transferred into recoils is calculated. (D.L.C.)

52221 (N-72-18074) ESTIMATION OF GALACTIC COSMIC-PENETRATION AND DOSE RATES. Burrell, M. O.; Wright, J. J. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). Mar 1972. 43p. (NASA-TN-D-6600; M-444). NTIS.

Approximation methods are presented that can be readily applied to estimate the absorbed dose rate from cosmic rays in rads—tissue or rems inside simple geometries of aluminum. The present work is limited to finding the dose rate at the center of spherical shells or behind plane slabs. The dose rate is calculated at tissue-point detectors or for thin layers of tissue. This study considers cosmic-rays dose rates for both free-space and earth-orbiting missions. (auth) (STAR)

52222 (ORNL-tr-2533) STUDIES ON RADIATION ATTENUATION IN SHIELDS WITH CONCRETE-IMBEDDED PIPELINES. II. Futtermenger, W. (Technische Universitaet, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-TUH-1066. 10p. Dep. NTIS.

Additional measurements of γ-ray propagation at an energy of 660 keV were made in 45° and 90° pipe bends in concrete-block shields. A ^{137}Cs source was used, the pipes varied in diameter from 15 to 40 mm, and the bends had a radius of curvature of 25 cm. The results are compared with those of ABS-TUH-1060 for 250 keV γ rays. For 45° bends, constant attenuation factors can be used in the energy region 0.3 to 1 MeV. For 90° bends, attenuation is so high that the dose rate measurements are falsified by background radiation. (D.L.C.)

52223 (SC-DC-721144) EMP RESPONSE OF A CAVITY: FIELD GENERATION WITHIN A LOSSY DIELECTRIC CYLINDER EXCITED BY A RADIATION PULSE. Mangan, D. L.; Scrivner, G. J. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 22p. (CONF-720707-9). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA, (24 Jul 1972).

A transient electromagnetic field problem is solved for a finite-length cylindrical cavity bounded by perfectly conducting walls. The cavity is filled with a homogeneous lossy dielectric material. Analytic solutions for the relevant components of the electric and magnetic fields generated by an axially propagating current pulse are presented. Results obtained for various sample problems are discussed. (auth)

52224 (SC-RR-720165) ADEQUACY OF A STRAIGHTFORWARD PERTURBATION EXPANSION FOR ESTIMATING THE ELECTROMAGNETIC RESPONSE WITHIN A LOSSY DIELECTRIC CYLINDER EXCITED BY A RADIATION PULSE. Scrivner, G. J.; Mangan, D. L. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 73p. Dep. NTIS.

A straightforward (pedestrian) approximation scheme is applied to a transient electromagnetic field problem associated with a finite-length cylindrical cavity bounded by perfectly conducting walls. The cavity is filled with a homogeneous lossy dielectric material. Analytic expressions for the zeroth- and first-order terms of the perturbation solution for each of the relevant components of the electric and magnetic fields generated by an axially propagating current pulse are presented. Results obtained for various sample problems are examined and comparisons with the exact solutions are highlighted. The adequacy and limitations of such an approximation scheme are discussed. (auth)

52225 X-RAY$_{\gamma 2,3}$ SPECTRUM IN THE OXIDATION OF RARE EARTH ELEMENTS. Demekhin, V. F.; Platkov, A. I.; Sukhorukov, V. L.; Bairachnyi, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 2, 352-3(Feb 1972). (In Russian).

The $L_{\gamma 2,3}$ spectra of rare earth elements were obtained in a DRS spectrograph. It was shown that the $L\gamma_{10}$ and $L\gamma_{11}$-long-wave satellites may not be the result of an interaction of 4p holes and 4f incompleted shells. These satellites of the elements studied were explained on the basis of transitions of 4p electrons into 2s vacancies with the simultaneous ejection of 5s electrons. (tr-auth)

52226 CALCULATION OF DOSE CONVERSION FACTORS FOR ^{60}Co GAMMA RADIATION IN WATER. Eisenlohr, H. H.; Abedin-Zadeh, R. (International Atomic Energy Agency, Vienna). Strahlentherapie; 143: No. 4, 410-15(Apr 1972). (In German).

The dose conversion factors f and g, and the water—air ratio were calculated for ^{60}Co gamma radiation and water as the ratio of the corresponding depth doses. The results obtained are in good agreement with the recommended values. The dose conversion factors f and g are independent of both depth in water and field size within the regions investigated. (auth)

52227 RANGE OF FISSION FRAGMENTS IN LIGHT SOLID MATERIALS. Demichelis, F.; Liscia, R.; Tartaglia, A. (Politecnico, Turin). Nuovo Cim.; 10B: No. 2, 523-36(11 Aug 1972).

The range of several fission fragments in Be, C, Al and Si was measured. The results are converted to the Lindhard—Scharff—Schiøtt (LSS) dimensionless parameters, and compared with the existing theory. A detailed comparison with Bohr's theory is not possible because there is not enough experimental information on the parameters of the theory. The measurements in Al and Si agree within 7% with the LSS theory. The best fit for the parameter k is quite close to that of other authors. (auth)

52228 CALCULATION OF THE BOUNDARY EFFECT IN PARTICLE TRANSPORT PROBLEMS. Durinov, S. I.; Uchaikin, V. V.; Kol'chuzhkin, A. M. At. Energ. (USSR); 32: No. 6, 497-9(Jun 1972). (In Russian).

A particle flux at the boundary of a medium—a vacuum under the conditions of plane-parallel geometry—may be expressed by a particle flux in a homogeneous infinite medium and a differential albedo, the numerical value of which is available in the literature. Formulas are developed that are utilized in the example of the dose buildup factor behind layers of concrete at various angles of incidence for 1-MeV γ quanta. It is suggested that the formulas developed are also applicable to problems involving neutrons, electrons, and other particles. (K.S.W.)

52229 SURFACE IONIZATION RATIOS (S.I.R.) FOR ELECTRONS IN THE ENERGY RANGE 3-11 MeV AND THE IMPLICATIONS FOR TREATMENT OF SUPERFICIAL LESIONS. Orchard, P. G.; Martin-Smith, P. (Royal South Hants Hospital, Southampton, Eng.). Brit. J. Radiol.; 44: No. 526, 817(Oct 1971).

Experiments were made to measure the S.I.R. (ratio of dose at the surface to dose at the maximum in the depth-dose curve) of 3- to 11-MeV electrons. Most measurements were made in a water phantom with an ionization chamber 14 mm × 0.8 mm having a 61 mg cm^{-2} window. The front window was of perspex 0.5 mm thick with a conducting aluminum layer of 1.3 mg cm^{-2}. Others were made using photographic film vacuum packed in plastic envelopes and irradiated end-on between the machined faces of a polystyrene block phantom. With small fields 5 to 10 cm diameter, at energies of 3 to 8 MeV, it was found that the dose at the surface could be less than 80% of the dose at the maximum depth. (UK)

52230 CORRECTION OF DOSE DISTRIBUTION FOR AIR SPACE IN HIGH-ENERGY ELECTRON BEAM THERAPY. Okumura, Yutaka (Aichi Cancer Center, Nagoya, Japan). Radiology; 103: No. 1, 183-6(Apr 1972).

A simple correction of the dose distribution of an electron beam for the oblique incidence is to shift the standard isodose curves the distance of the air space. The error of the corrected distribution from the measured one was more than 10% when the space was more than 3 cm. The electron beam diverged approximately in accordance with the inverse-square law when the scattering foil was assumed to be the virtual source. Correction of the air space shifting and the inverse square law resulted in an error less than 3%. (auth)

52231 EVALUATION OF SIEVERT'S INTEGRAL BY COMPUTER. Worthley, B. W.; Nicholls, R. L. (Univ. of Adelaide). Australas. Bull. Med. Phys. Biophys.; No. 54, 18-22(1 Jun 1972).

A program listing in FORTRAN for a CDC 6400 is given. It is based on a series expansion of the exponential term in $G(k,X) = \Sigma_{m=0}^{M} A_m \int_0^X \sec^m x\, e^{-k \sec x}\, dx$, which reduces to Sievert's integral when $M = 0$ and $A_0 = 1.0$. (Australia)

52232 INCOHERENT SCATTERING OF PHOTONS BY BOUND ELECTRONS. Pingot, O. J. Phys. (Paris); 33: No. 2-3, 189-90 (1972). (In French).

The differential cross section for the incoherent scattering of 279-keV γ rays by the K-shell electrons of tantalum, samarium, and silver was determined experimentally. This cross section is compared with the Klein—Nishina cross section for scattering angles between 20 and 160°. The results are in fairly good agreement with the Shimizu function. (France)

52233 BREMSSTRAHLUNG CROSS-SECTION MEASUREMENTS AT AN INCIDENT ELECTRON ENERGY OF 0.2 MeV ON Al, Cu, AND Au. Rester, D. H. (Advanced Tech. Center, Inc., Dallas, Tex.); Edmonson, N. Phys. Rev., A; 6: No. 4, 1405-9(Oct 1972).

Electron-bremsstrahlung cross-section values differential in photon energy and angle are given for a bombarding energy of 0.2 MeV. Measurements were made for photon energies from 0.02 to 0.06 MeV with a Ge(Li) spectrometer and from 0.06 to 0.2 MeV with a NaI-crystal-scintillation spectrometer for photon emission angles of 10°, 20°, 30°, 45°, and 60°. Targets of Al, Cu, and Au were used. Comparisons are made to the Born-approximation values. (auth)

52234 MEASUREMENT OF MOLECULAR STOPPING CROSS SECTIONS OF HALOGEN—CARBON COMPOUNDS AND CALCULATION OF ATOMIC STOPPING CROSS SECTIONS OF HALOGENS. Powers, D.; Chu, W. K.; Robinson, R. J.; Lodhi, A. S. (Baylor Univ., Waco, Tex.). Phys. Rev., A; 6: No. 4, 1425-35(Oct 1972).

Molecular stopping cross sections ϵ_α of α particles of energy 0.3 to 2.0 MeV were measured (probable error 0.9 to 2.1%) in gaseous (or vapor) CF_4, C_2F_6, C_3F_8, C_4F_8, CCl_4, $CClF_3$, CCl_2F_2, $CHCl_2F$, $CBrF_3$, $C_2Br_2F_4$, C_2H_3Br, C_2H_5Br, and C_2H_5I. Atomic stopping cross sections for F, Cl, Br, and I were calculated (probable error 2.3 to 4.4%) by application of the Bragg additive rule. It is found that carbon $\epsilon(C)$ calculated from gaseous fluorocarbons agrees with previous measurements by Chu and Powers of $\epsilon(C)$ for carbon in solid form but disagrees with $\epsilon(C)$ calculated from gaseous hydrocarbons by Bourland, Chu, and Powers. Consistent results are found by using either of two alternatives: (i) use hydrocarbon gas $\epsilon(C)$ and experimental $\epsilon_{\text{expt}}(H_2)$ in hydrogen-enriched C—H—Br or C—H—I compounds, and use solid carbon $\epsilon(C)$ everywhere else; or (ii) use solid carbon $\epsilon(C)$ in all compounds, but use an $\bar{\epsilon}'(H)$ that disagrees by as much as 21% from $\frac{1}{2}\epsilon_{\text{expt}}(H_2)$. A plot of ϵ_α vs the atomic number Z_2 of the stopping medium shows that the halogen measurements at $Z_2 =$ 9, 17, 35, and 53 agree well with the existing theory and other experimental measurements for neighboring Z_2 values. (auth)

52235 TOTAL ABSORPTION MEASUREMENTS FOR 250- TO 1000-MeV PHOTONS IN CARBON, ALUMINUM, AND TITANIUM. Miyachi, Takashi (Tokyo Univ.); Akino, Yoshio; Gomi, Kazuo; (and others). J. Phys. Soc. Jap.; 33: No. 3, 577-84(Sep 1972).

Total absorption cross sections of photons in carbon, aluminum, and titanium were studied for photon energies at 250, 450, 700 and 1000 MeV. The bremsstrahlung beam produced by the 1.3-GeV electron synchrotron at the Institute for Nuclear Study was used as the source of high-energy photons. The detection of high-energy photons was made by a magnetic pair spectrometer. Experimental results agree with theoretical calculations on the total absorption cross section for photons within experimental errors. (auth)

52236 PHOTON—ELECTRON TRANSFORMATION IN NONHOMOGENEOUS ABSORBERS DURING EMISSION OF BREMSSTRAHLUNG. Vorob'ev, V. A.; Gelashvili, Sh. Sh.; Kolbin, A. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 140-2(1972). (In Russian).

During passage of a flux of quanta through matter, besides an accumulation of secondary radiation, a flux of secondary electrons is also formed. A photon—electron transformation in barriers of certain metals and alkali halide crystals was investigated for the emission of bremsstrahlung with various energy maxima. (K.S.W.)

Radiation Protection Standards

Refer also to abstracts 50859–50862 and 50898.

52237 ADEQUACY OF PRESENT STANDARDS OF RADIATION EXPOSURE. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.). Environ. Aff.; 1: No. 1, 91-139(Apr 1971).

Energy is discussed as a source of pollution, and more specifically, the effects of ionizing radiation as a pollutant and the adequacy of present standards of radiation exposure are considered. The following topics are covered: the basic assumptions of the International Commission on Radiological Protection (ICRP) in setting radiation protection standards, recommended dose limits, radiation exposure experience, comparison of radiation risks with other risks, and the possible consequences of present radiation exposure limits. (M.H.R.)

52238 LEGAL AND ADMINISTRATIVE ASPECTS OF PERSONNEL DOSIMETRY. Hart, J. C. (Oak Ridge National Lab., Tenn.). Health Phys.; 23: No. 3, 343-8(Sep 1972).

The record generated in a personnel dosimetry program should be of a type that will satisfy legal, administrative, and technical requirements. Legislative machinery operating at the federal, state, and municipal levels is beginning to place statutes on the books that are intended to alleviate some of the problems experienced in the last decade. However, an important consideration that will continue to harass is the custom which suggests that a particular technique or practice be generally accepted by experts in the field who are responsible for utilizing the technique or practice. Courts prefer to deal with the written record when weighing evidence, and rules that govern the admissibility of evidence need to be understood if the data generated by a dosimetry system are to have maximum evidentiary value. It appears evident that the availability of modern computer techniques makes it possible to record lifetime radiation dose involving both medical and occupational exposures provided (1) dosimetry techniques and reporting methods are somewhat standardized and (2) enabling legislation at the federal, state, and municipal levels is achieved, which will require that (a) dose determinations be made and recorded by the responsible agency when individuals are exposed, (b) individuals for whom radiation dose is determined will be positively identified through the use of the social security number or some such identification system, and (c) the dose derived for each individual exposed is reported to a central agency where cumulative exposures are consolidated. (auth)

Radiation Source Calibration and Standardization

Refer also to abstract 51980.

Shielding Calculations and Theory

Refer also to abstracts 51970, 52222, 52354, 52357, 52583, 52590, and 52636.

52239 (AD–739339) SYSTEM OF SHIP-SHIELDING CODES. Final Report. Newell, J. M.; French, R. L.; Kimmell, R.; Mooney, L. G. (Radiation Research Associates, Inc., Fort Worth, Tex.). 20 Mar 1972. 61p. (RRA-T–706; DNA–2767-T). NTIS.

A system of three machine codes was developed to calculate the protection against initial radiation from nuclear weapons that may be afforded aboard ship. The codes were written in FORTRAN and are operational on the IBM 360, Models 75 and 91, computer systems at Oak Ridge National Laboratory (ORNL). (auth) (NTIS)

52240 (AEC-tr–7138, pp 12-16) DOSE BUILDUP FACTOR FOR A POINT ISOTROPIC ^{137}Cs SOURCE IN SPHERICAL GEOMETRY. Rodionov, Yu. A. Translated from Radiats. Tekh.; No. 3, (1969).

The Monte Carlo method was used to investigate the dependence of the buildup factor on the shield curvature and the shield–detector distance for a spherical shield. The effect of shield thickness for a point isotropic ^{137}Cs source is shown on surfaces of spherical water, iron, and lead shields. As data for infinite media and for a flat shield are also included for comparison, the correction for the buildup factor can be determined. It was concluded that the curvature of the shield has little effect on the buildup factor (the difference between flat and spherical shields was 12% for water and 4% for lead for shield thicknesses equal to four times the mean free path length). The buildup factor is practically independent of the distance, and the effect of distance may be disregarded (with an accuracy up to 10%). (1 figure, 2 tables) (R.W.R.)

52241 (AEC-tr–7138, pp 16-19) EFFECT OF CONSTRUCTIONAL GASKETS AND GAPS ON THE THICKNESS OF THE BIOLOGICAL SHIELD IN AN ISOTOPIC GENERATOR. Terent'ev, V. P.; Zorina, T. P. Translated from Radiats. Tekh.; No. 3, (1969).

Initial calculations of biological shielding required by an isotope generator can be only approximate as the details of the design are not yet known. The calculations of the shield should, therefore, be presented in the form of functions and recommendations that the designers can use in the drafting stage for the rapid determination of the shield thickness. The nature and the form of the results that have to be obtained at the end of the shield calculation stage are discussed. (2 figures) (R.W.R.)

52242 (BMBW-FBK–71-2(Suppl.)) TABULATED VALUES OF SPATIAL, DIRECTIONAL, AND ENERGY DISTRIBUTIONS OF MULTIPLE SCATTERED GAMMA RADIATION. Stehfest, H. (Frankfurt Univ. (West Germany). Institut fuer Angewandte Physik). Dec 1971. 87p. (In German). Dep. NTIS (U. S. Sales Only).

With a new Monte Carlo technique, previously described in BMBW-FBK-71-2, the distribution of multiple scattered gamma quanta as to their location, their direction, and their energy was calculated. The present report contains the results of these calculations in the form of tables. Point-isotropic, plane-perpendicular, and point-collimated sources in the scattering media water, iron, tin, and lead were investigated. As source energies 0.662, 1.25, and 3 MeV were chosen. The distances from the source were 1, 4, 10, and 20 mean free paths of the primary radiation. In all the cases the spectra were computed for both infinite and slab geometry. (auth)

52243 (LA-DC–72-749) DEVELOPMENT OF ENDF/B SHIELDING DATA, PROCESSING CODES, AND INTEGRAL TESTS. LaBauve, R. J.; Seamon, R. E.; Weisbin, C. R.; Harris, D. R.; Muir, D. W. (Los Alamos Scientific Lab., N. Mex.). [nd]. 12p. (CONF-720901–5). Dep. NTIS.

From Meeting of new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

The national Evaluated Nuclear Data File (ENDF/B) now contains twelve materials important for shielding applications; these evaluations include data for neutron-induced photon production. During fiscal year 1973, photon production data for at least ten more important materials will become available, and six new photon production evaluations will be undertaken. Existing processing codes are being extended and improved, and new codes are being written to fully exploit the extensive data included in the ENDF/B. A comprehensive data testing program under the direction of the Cross Section Evaluation Working Group (CSEWG) is under way to uncover data deficiencies and suggest areas for improvement. (auth)

52244 (ORNL–4763) TRAPP, A COMPUTER PROGRAM FOR THE TRANSPORT OF ALPHA PARTICLES AND PROTONS WITH ALL NUCLEAR-REACTION PRODUCTS NEGLECTED. Barish, J.; Santoro, R. T.; Alsmiller, F. S.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 72p. Dep. NTIS.

TRAPP is a Fortran IV program primarily intended for carrying out studies of the shielding required to protect astronauts against Van Allen belt protons and against solar-flare protons and alpha particles. The program treats the transport of protons and alpha particles through a homogeneous shield and tissue with the assumptions that all nuclear-reaction products may be neglected and all particles travel in a straight line and undergo a continuous slowing down. The geometry considered is that of a spherical shell shield with a tissue sphere at its center. For an isotropically incident proton or alpha-particle flux per unit energy with maximum energy ≤ 3 GeV, the program gives the particle flux per unit energy, the absorbed-dose rate, and the dose-equivalent rate at the center of the tissue sphere as a function of the spherical-shell-shield thickness. (auth)

52245 (ORNL-RSIC–13(Vol.3)) ABSTRACTS OF DIGITAL COMPUTER CODE PACKAGES ASSEMBLED BY THE RADIATION SHIELDING INFORMATION CENTER. Maskewitz, Betty F. (Oak Ridge National Lab., Tenn.). Aug 1972. 232p. Dep. NTIS.

ORNL-RS13-13, Volume I contains abstracts of each code package in the RSIC Computer Code Collection CCC-1 through CCC-58, published 1966-67. Volume II continues with CCC-59 through CCC-115, 1968-1969. Volume III currently contains CCC-116 through CCC-168, packaged 1970-1972. Each abstract in Volume III covers the following: name and title of code, contributor, coding language and computer, nature of problem solved, method of solution, restrictions or limitations, typical running time, computer hardware requirements, computer software requirements, reference, contents of code package, how to obtain package, and date of abstract. (M.H.R.)

52246 EVALUATION OF INTENSITY VARIATION OF BREMSSTRAHLUNG FOR PLANE LAYER WITH CYLINDRICAL CAVITY. Vorob'ev, A. A.; Vorob'ev, V. A.; Tarasov, G. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 123-5(1970). (In Russian).

The author concludes that in transmission of a plane layer with a cavity perpendicular to a 5- or 30-MeV bremsstrahlung beam, the position of the cavity and its forms are unimportant in the intensity perturbation by the layer. (T.S.S.)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstract 50204.

52247 (AD–736771) THERMOLUMINESCENCE OF YTTRIUM OXIDE SINGLE CRYSTALS. Land, Peter L.; Rodine, Edward T. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Nov 1971. 114p. (ARL–71-258). NTIS.

The report describes the thermoluminescence (TL) of six single crystals of yttrium oxide which are either rare-earth-doped or nominally pure. The fluorescence, coloration, and absorption behavior are also included. The glow peaks that are observed are sometimes common to several crystals and to other yttria samples studied here or elsewhere. The temperature dependence of the TL is analyzed to provide the energy and frequency factors appropriate to the major electronic traps. (auth) (NTIS)

52248 (CEA-CONF–1948) SWITCHING EFFECT IN SILICON OXIDES DOPED BY ION IMPLANTATION. Note No. 773. Le Goascoz, V.; Borel, J.; Rigaux, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 26 Aug 1971. 17p. (In French). (CONF-710932–3). Dep. NTIS (U. S. Sales Only).

From third international symposium on the application of vacuum techniques in semiconductor industry, electronic components, and microelectronics; Versailles, France (13 Sep 1971)

Preliminary results from the doping of amorphous insulators by means of ion implantation are presented. The modification of the conductivity of the layers was studied as a function of the doping (phosphorus). By means of an appropriate forming process, devices having a memory-switching phenomenon were developed. The switching thresholds are low and permit the compatibility of these devices with standard command circuits. (tr-auth)

52249 (CONF-710958–2) RESONANCE EFFECT IN THE GENERATION-RECOMBINATION NOISE SPECTRUM OF ^{60}Co GAMMA IRRADIATED GERMANIUM SINGLE CRYSTALS. McCarter, Ed R. (Florida Technological Univ., Orlando (USA)). 1971. 8p.

From International conference on the noise in active semiconductor devices; Toulouse, France (21 Sep 1971).

Investigations using germanium single crystals were conducted to establish a reversible method for use in generation–recombination (g–r) noise measurements. This method uses radiation consisting of fast (14.1-MeV) neutrons and ^{60}Co gamma rays. By irradiating a germanium single crystal, additional lattice defects are introduced which reduce the lifetime in a controlled manner. The noise spectrum is modified according to the relation $\tau/(1 + \omega^2\tau^2)$ which provides a convenient method for changing the noise properties, while leaving all other crystal parameters unchanged. In all cases, using fast-neutron irradiation, the noise spectrum could be explained by the present g–r noise theory. However, some very interesting results were obtained with the ^{60}Co gamma rays which cannot be explained with the present g–r noise theory. After an irradiation dose of 1.4×10^{18} γ/cm^2, a resonant-type peak occurred near the break point of the g–r spectrum which is unexplainable using the present theory. An interesting point is that the resonant peaks are only observed at temperatures about the local maxima of the noise spectrum. Subsequent annealing at 350°C restored the crystal to very near its original condition. (auth) (France)

52250 (COO–1105-178) EFFECT OF FAST NEUTRON IRRADIATIONS ON THE TRIPLET EXCITON LIFETIME IN ANTHRACENE CRYSTALS. Pearson, D. W.; Moran, P. R. (Wisconsin Univ., Madison. Dept. of Physics). [nd]. 9p. Dep. NTIS.

The effect of γ and fast-neutron irradiations on the delayed blue fluorescence of anthracene crystals is to increase the triplet exciton decay rate β according to $\beta = \beta_0 + \alpha R$. Typical values of α are: for γ rays, $\alpha = 0.14$ sec^{-1} rad^{-1}; for fast neutrons, α = 0.3 sec^{-1} rad^{-1} for 14 MeV (1 "rad" = 2×10^8 n/cm^2 . The delayed blue fluorescence samples the triplet exciton population via the bimolecular triplet–triplet annihilation interaction. Direct observation of the triplet red phosphorescence by Smith showed that, while the time dependence of the triplet concentration could be obtained from the rate of delayed blue fluorescence emission, the actual triplet concentration could not. He suggested this might imply the existence of triplet traps that would affect the bimolecular interaction rate but not change triplet concentrations or lifetimes. To find out whether observed radiation damage effects were due to radiative or nonradiative triplet quenching or to triplet trapping, it was decided to measure the triplet red phosphorescence directly. Preliminary results indicate that the radiation damage is an increased nonradiative decay of the triplet exciton. (auth)

52251 (IAE–2124) CONCENTRATION OF POINT DEFECTS IN CARBONIC MATERIALS. Nikolaenko, V. A.; Alekseev, S. I.; Platonov, P. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The dependence of the distance between carbon atoms on the magnitude of the bond strength was used to explain changes in lattice parameters of diamond and graphite as a result of irradiation. The expansion of diamond was caused by the effects of intermediate atoms. The expansion of graphite perpendicular to the base and its contraction in the plane of the base is explained by the presence of vacancies. The concentration of point defects in irradiated diamond and graphite was estimated, and the anomalous increase in the "C" parameter during the annealing of graphite irradiated at –195°C is discussed. (tr-auth)

52252 (UCRL–73826) X-RAY INDUCED PHOTOCONDUCTIVITY IN DIELECTRIC FILMS. Weingart, R. C.; Barlett, R.; Lee, R. S.; Hofer, W. (California Univ., Livermore. Lawrence Livermore Lab.). Mar 1972. 5p. (CONF-720707–12). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

X-ray induced conductivity was measured in mylar, kapton, teflon, polyethylene, epoxy, and borosilicate glass samples at dose rates between 10^9 and 10^{10} rads/sec (dose in air). The photocurrents were found to obey Ohm's law for electric fields less than 10^5 V/cm. At higher fields departures from ohmic behavior were observed in mylar, polyethylene, and kapton. The delayed conductivity (conductivity persisting after the radiation pulse) was observed to be electric-field-dependent in mylar, kapton, and teflon. The magnitude and time dependence of the observed photocurrents are qualitatively described by a simple trapping model using reasonable values for mobility, trap density, trap depths, and capture cross sections for trapping. (auth)

52253 RADIATION-INDUCED DIFFUSION OF ALKALI IONS AND PROTONS IN QUARTZ. Samoilovich, M. I.; Tsinober, L. I.; Khadzhi, V. E.; Gordienko, L. A. (All-Union Scientific-Research Inst. for Synthesis of Mineral Raw Materials, Moscow). Sov. Phys.-Cryst. (Engl. Transl.); 17: No. 1, 147-50(1972).

Translated from Kristallografiya; 17: No. 1, 184–8(1972).

Studies of the radiation color centers in quartz by ir spectroscopy and EPR have shown that ionizing radiation causes the diffusion of alkali ions. This process is related to the formation of Al centers of a smoky color and to electron capture at various types of centers. In contrast with the case of alkali ions, proton motion is observed only with reactor irradiation. The nature of this phenomenon and its relation to structural features of quartz are discussed. (auth)

52254 STUDIES ON BOMBARDMENT-ENHANCED CONDUCTIVITY. I. INCREASE IN THE ELECTRICAL CONDUCTIVITY OF MoO_3 AND V_2O_5 FOLLOWING ION BOMBARDMENT. Naguib, H. M.; Kelly, R. (McMaster Univ., Hamilton, Ont.). J. Phys. Chem. Solids; 33: No. 9, 1751-9(Sep 1972).

Measurements of the sheet conductivity of ion-bombarded MoO_3 and V_2O_5 show that there is a conductivity increase of many orders of magnitude for doses of 2×10^{16} to 2×10^{17} ions/cm^2 of 40-keV Kr, the final bulk conductivities being 20 to 200 Ω^{-1} cm^{-1} for MoO_3 and 20 to 600 Ω^{-1} cm^{-1} for V_2O_5. Reflection electron diffraction indicates major structural changes in the irradiated materials. Thus the initially crystalline MoO_3 and V_2O_5 first amorphize (1×10^{13} and 2×10^{14} ions/cm^2, respectively) but subsequently crystallize to lower oxides, the appearance of the latter being an indication of bombardment-induced oxygen loss. The lower oxides, MoO_2 and V_2O_3, are known from other work to be metallic at room temperature, and there is thus no difficulty in attributing the increase in conductivity to their formation. The reason for bombardment-induced oxygen loss with MoO_3 and V_2O_5 is only partly understood. The fact that the altered layers have thicknesses of roughly 1150 ± 250 Å suggests, however, that neither normal sputtering nor bombardment-enhanced vaporization is by itself the cause. Rather, a long-range effect, i.e., one that correlates with the ion mean range or which involves diffusion, must be participating. The conductivity increases found are regarded as having several important applications. For example, they imply a severe limitation on the use of MoO_3 or V_2O_5 in a radiation environment though at the same time they suggest a new approach in developing solid-state devices. (auth)

52255 ELECTRONIC AND MAGNETIC PROPERTIES OF CARBON FIBRES: CHANGES UNDER NEUTRON IRRADIATION.

Rappeneau, J.; Micaud, G.; Drouet, A.; (and others) (CEN de Saclay, Gif-sur-Yvette, France). Carbon; 10: 455-62(1972). (In French).

Techniques developed for the measurement of the electrical resistivity and the diamagnetic anisotropy of carbon fibres in the temperature range 77 to 300°K are described. Two types of fibres were studied: Rigilor AC fibres treated at 1100°C and Rigilor AG fibres treated at 2500°C. The measurements of electrical resistivity performed on single fibres showed the presence of some correlation between this property and the cross-sectional area of the fibre. Measurements of diamagnetic susceptibility carried out on bundles of fibres demonstrated a large anisotropy of the fibres. The influence of small neutron-irradiation doses on these properties was studied at room temperature. (auth)

52256 THERMAL ANNEALING OF NEUTRON IRRADIATED CARBONS: CHANGES IN ELECTRONIC PROPERTIES. Pacault, A.; Marchand, A.; Amiell, J.; (and others) (Univ. Bordeaux, Talence, France). Carbon; 10: 449-54(1972). (In French).

In continuation of a study of the electronic properties of neutron irradiated carbons the resulting changes in their electronic properties (electrical resistivity, Hall effect, magnetoresistivity, magnetic susceptibility) were determined after various thermal anneals. Similarities in behavior of PGCCL and graphite were observed. The pyrocarbon, which was damaged most easily, recovered its initial properties with the most difficulty. However, the previous damage did not affect its behavior during graphitization. Previously started measurements of the electron spin resonance were completed. (auth)

52257 INFLUENCE OF PRECIPITATES ON THE FORMATION OF CAVITIES IN AN Al-4 PERCENT Cu ALLOY IRRADIATED WITH FAST NEUTRONS. Risbet, A.; Levy, V. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Mater.; 44: No. 1, 113-15(Jul 1972). (In French).

The swelling under irradiation of Al 4%—Cu alloys in which a wide variety of precipitates from the coherent Guinier—Preston (GP) zones to the incoherent θ phase had been induced was studied. The results showed that the swelling of the alloy containing GP_1 zones was ten times less than that of pure Al. In order to explain the order of magnitude of the variation of swelling, it was necessary to attribute an important role to the interfaces. Cavities were observed only in the case of coherent zones. When the precipitates were semicoherent, a large number of dislocations on the precipitates were observed. In the case of incoherent precipitates some helices were observed. (J.S.R.)

52258 DIFFUSION OF ION-IMPLANTED ^{85}Kr IN KCl, INCLUDING THE EFFECTS OF CHANNELING, RADIATION DAMAGE, AND DIVALENT DOPING. Pronko, P. P.; Kelly, R. (McMaster Univ., Hamilton, Ont.). J. Phys. Chem. Solids; 33: No. 9, 1761-72(Sep 1972).

An expanded study of the diffusion of ion-implanted ^{85}Kr in KCl was undertaken with improved analytical and experimental techniques. These include an analysis of diffusion profiles, separation of the effects of radiation damage from those of the normal lattice (by chemically stripping the damaged region), and use of specimens which are doped with $CaCl_2$. Diffusion coefficients are examined in the context of diffusion theory where D is assumed, in the case of unstripped samples, to have the following spatial variation: $D = D_1(1 + cx)^{1/2}$ for $0 \leq x \leq a$, and $D = D_1(1 + ca)^{1/2}$ for $x \geq a$. The results reveal two diffusion components, the one occurring from 175 to ≥ 250°C and the other occurring from ≥ 250 to at least 500°C. The high-temperature component is shown to involve interstitial migration in the presence of cation—vacancy traps. Thus (a) the depth profiles were indicative of normal diffusion kinetics, (b) the process was better defined in stripped (i.e., damage-free) specimens, (c) there was an inverse correlation with $CaCl_2$ doping provided the specimens were stripped, and (d) the ΔH of 2.1 eV agreed fairly well with Norgett's theoretical value of about 1.7 eV. The low-temperature component was less readily explained, though for reasons which are essentially the converse to those given above may be assumed to involve Kr interaction either with unspecifiable damage centers or with other gas atoms. (auth)

52259 DOSIMETRY OF π^--MESONS USING SILICON DETECTORS AND PLASTIC SCINTILLATORS. Raju, M. R.; Lampo, E.; Curtis, S. B.; Richman, C. (Univ. of California, Berkeley). Phys. Med. Biol.; 16: No. 4, 599-610(Oct 1971).

The dosimetry of both π^+ and π^--beams, by use of semiconductor detectors and plastic scintillators, is described. Tissue equivalent phantom studies on depth-dose distributions, isodose distributions, and integral and differential range curves are presented. By use of a time-of-flight system, the dosimetric information for a pure pion beam was obtained. The muon and electron contamination reduced the peak-to-plateau ratio. Pion beams of low energy gave better depth-dose distributions. Nearly 50% of the dose at the peak of the depth-dose distribution of a π^--beam was found to be due to nuclear events. Depth-dose distributions measured by semiconductor detector and tissue-equivalent ionization chamber, were in close agreement with each other. (auth)

52260 EFFECTS OF IRRADIATION WITH PROTONS ON THE CRYSTALLOGRAPHIC ORDER OF THE COMPOUND Bi_2Te_2Se. Gangulee, A. (IBM Watson Research Center, Yorktown Heights, N. Y.); Bever, M. B. Phil. Mag.; 26: No. 2, 337-48(Aug 1972).

Specimens of the compound Bi_2Te_2Se were prepared in the form of pressed powder briquettes and were thermally treated to attain the ordered and the disordered states. These specimens were then subjected to irradiation with 7.5-MeV protons in cumulative doses to a maximum integrated dose of 2×10^{18} protons/cm^2. After each irradiation the specimens were examined by x-ray diffraction with monochromated cobalt Kα radiation. In initially ordered specimens, irradiation with protons reduced the lattice order and caused disorder in all three sublattices occupied by bismuth, selenium, and tellurium atoms. This disordering is different from thermal disordering, which is confined to the Se and the Te sublattices. Irradiation of specimens with initial thermal disorder produced some lattice order and caused disorder in the Bi sublattice. The final states of order in both the initially ordered and the initially disordered specimens were remarkably similar. The results are interpreted in terms of atomic displacements, movements of defects, and thermal spikes. (auth)

52261 KINETICS OF REVERSIBLE AGGLOMERATION OF F_1 AND F_2 CENTERS IN TRACKS OF PROTONS IN NaCl CRYSTALS. Vaisburd, D. I.; Melikyan, L. A.; Terent'ev, N. L. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 33-9(1970). (In Russian).

When a charged particle interacts with condensed media, the energy transferred is localized in a small volume called a track, the average diameter of which is ~50 Å. Results are presented here from experimental studies of the characteristics of tracks of 4.75-MeV protons in NaCl crystals at 295°K and compared with computer estimates using the least-squares method. The track volume was 1.75×10^{-15} cm^3 and track diameter was 30 Å; the coalescence volume $F_1 \rightarrow F_2$ centers was 0.72×10^{-19} cm^3; the level of saturation of fast-stage accumulation of F_1 centers was 1.61×10^{17} cm^{-3}; the effective accumulated concentration of F_1 centers on linear stages in proton tracks was 0.55×10^{18} cm^{-3}/proton; the concentrations of F_1 and F_2 centers in the track of one proton were 0.71×10^{18} cm^{-3} and 1.8×10^{-16} cm^{-3}, respectively; the volumetric transfer of energy was 1.7×10^{21} eV/cm^3 or 0.1 eV/molecule; and the forbidden band width of NaCl was Eg = 8.5 eV. The creation of one electron—hole pair required an average 2Eg = 17 eV, and it was found that elementary excitations (electrons, holes, excitons) originate in the proton track at a distance of eight interatomic spaces; this was less than the interaction radius of the elementary excitations. (T.S.S.)

52262 INFLUENCE OF PRELIMINARY IRRADIATION ON THE KINETICS OF RADIATION BUILDUP OF F CENTERS IN KCl MONOCRYSTALS CONTAINING CATION-SUBSTITUTING IMPURITIES. Melik-Gaikazyan, I. Ya.; Kurakina, E. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 144-6(1970). (In Russian).

Kinetic curves were obtained of the buildup of F centers in KCl and KCl : Pb single crystals with and without preliminary irradiation and for repeated irradiation (up to 10 hr) with x and visible radiation simultaneously; the repeated irradiation of KCl : Pb (after preliminary irradiation) increased the concentration of F centers from 10^{15} to 10^{17} cm^{-3}. No increase in concentration of color centers was observed in KCl : Sr crystals after the repeated irradiation (also preliminary irradiated) with x and visible radiation, or x and uv radiation, simultaneously. (T.S.S.)

Physical Properties

Refer also to abstracts 50204, 50228, 51027, 51075, 51077, 51096, and 51943.

52263 (CEA-CONF—2012) NUMERICAL STUDY OF THE ELECTRONIC AND THERMODYNAMIC PROPERTIES OF THE METAL—NONMETAL TRANSITION IN DENSE MEDIA. Fortin, X. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)); Schuttler, R. (Institut National des Sciences Appliquees, Toulouse (France)). 1972. 16p. (CONF-720423—3). Dep. NTIS (U. S. Sales Only).

From first European conference on computational physics; Geneva, Switzerland (10 Apr 1972).

The metal—nonmetal transition is a difficult theoretical field owing to its nonlinearity. A band model is set up which takes into account the influence of density and temperature. It is shown how computers may enable a numerical solution to be made in which the effect of physical input data on output can be analyzed. Band structures are presented for the insulator and conductor states, and results are given for dielectric constants of 1 and 10. The transition mechanism is discussed. (D.L.C.)

52264 (COO-1198-891) SCIENCE OF MATERIALS. Annual Progress Report. (Illinois Univ., Urbana. Materials Research Lab.). 15 Apr 1972. Contract AT(11-1)-1198. 71p. Dep. NTIS.

Summaries are presented of progress made in various projects in the fields of structure of materials, solid-state physics, crystal physics, and energetic-particle interaction. The projects include: solid-state transformations, electronic structure of transition-metal alloys, point defect-dislocation interactions, dislocations in composites, acoustic emission in stress-corrosion cracking, NMR, films, solid solutions of metals, very high pressure studies of matter, anharmonic effect in solids, defect and electronic properties of solids, rare-gas crystals, physics of refractory materials, and radiation damage. About 80 publications are listed. (D.L.C.)

52265 (HEDL-TME-72-83) ELECTRICAL PROPERTIES OF A POLYCRYSTALLINE ALUMINA SAMPLE. Schemmel, R. R.; Philipp, L. D.; Stringer, J. L.; Gordon, R. L. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 74p. Dep. NTIS.

The development of reactor instrumentation is being retarded from a lack of satisfactory and reliable signal levels resulting from inadequate insulation. Since system insulation differs greatly from ideal bulk materials, available data from the literature in journals, documents, or handbooks tend to be as often misleading as helpful. An attempt is made to solve some of these problems by providing information about the electrical properties of an alumina sample similar in composition to typical electrical connector insulation for a high-temperature cable system. An extensive review of the published literature on alumina is used to point out the expected effects of various parameters on the electrical properties. The experimental techniques and procedures are discussed in detail. with data presented on the results of temperature cycling, and on transient effects, due to time at temperature in atmosphere, on the electrical properties of alumina. These data are followed by initial breakdown-pulse-noise (BPN) results in an attempt to characterize the noise response of the basic insulator material. Results indicate that it is unlikely that atmosphere affects bulk stoichiometry at temperatures below 900°C. Volumetric changes noted result from grain-boundary diffusion and changes in the particulate surface states. These results suggest that actual conduction currents in low-density polycrystalline alumina may proceed along the particulate surface paths and grain boundaries in parallel with the bulk particles and grains. The observed BPN is intrinsic electrical noise occurring in discrete, short-duration current pulses, and has its origin in polarization phenomena, with breakdown occurring at discrete interfaces or voids within the dielectric. The onset threshold is a function of the temperature and voltage and shows both steady-state and transient characteristics. (87 references) (auth)

52266 (SC-T-722530) ON THE UNIVERSAL EQUATION OF STATE OF SOLID BODIES. Kalinin, V. A. Translated by Patricia Newman (Sandia Lab., Albuquerque, N. Mex.), from Izv. Akad. Nauk SSSR, Fiz. Zemli; No. 4, 16-23(1972). 17p. Dep. NTIS.

The variation in the thermodynamic characteristics of a substance associated with a slight change in its density and temperature is examined. Equations are given relating these quantities to temperature in the case of high temperatures. On the basis of contemporary theory of the equation of state of solids and with several assumptions concerning the nature of the interatomic forces, quite simple approximate equations are derived for the bulk modulus of compression, a seismic parameter, and the hydrodynamic speed of sound as functions of density. Several of these expressions have previously been derived empirically. (auth)

52267 THERMOPOWER AND RESISTIVITY STUDIES OF THE AuV AND AuCuV SYSTEMS. Singh, R. L.; Meaden, G. T. (Dalhousie Univ., Halifax, N. S.). Phys. Rev., B; 6: No. 7, 2660-8(1 Oct 1972).

The low-temperature transport properties of dilute AuV and AuCuV alloys were investigated by measuring their thermoelectric powers from 10 to 300°K and their electrical resistivities from 1.5 to 300°K. The alloys consisted of 0.4, 0.7, and 1.0 at. % vanadium dissolved in a $Au_{1-x}Cu_x$ host where $x = 0$, 10, and 20 at. %. It is shown that at low temperatures (<20°K), the resistivity of the AuV system can be described by a T^2 law. The implied Kondo temperature (280°K), however, is higher than that obtained by other means. In particular, the thermopower data suggest a Kondo temperature of 160°K for the AuV system. For temperatures exceeding 25°K, the impurity resistivity decreases linearly with increasing temperature. Reduced Nordheim–Goerter plots, prepared for estimating the characteristic thermopower of vanadium in Au and AuCu hosts, produce higher values than the experimental ones. Possible reasons are put forward. (auth)

52268 INDUCED-MOMENT FERROMAGNETISM IN Pr_3Tl. Andres, K.; Bucher, E.; Darack, S.; Maita, J. P. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 6: No. 7, 2716-23(1 Oct 1972).

It is shown that the intermetallic compound Pr_3Tl is a case of an induced-moment ferromagnet in which the nonmagnetic singlet ground state of Pr^{3+} is spontaneously polarized below 11°K due to slightly overcritical exchange interactions. By substituting only 7 at. % of La for Pr, both the ordered moment m_0 (at 0°K) and the Curie temperature T_C are reduced to zero, in contrast to the usual behavior of local-moment systems. The observed ratios of m_0/T_C for different La concentrations are compared with theoretical expectations. Specific-heat and resistivity anomalies at the transition are shown to be much reduced from what one would expect in an ordinary ferromagnet. (auth)

52269 NEUTRON SCATTERING FROM FCC Pr AND Pr_3Tl. Birgeneau, R. J. (Bell Telephone Labs., Murray Hill, N. J. Danish Atomic Energy Commission Research Establishment, Riso, Denmark); Als-Nielsen, J.; Bucher, E. Phys. Rev., B; 6: No. 7, 2724-9(1 Oct 1972).

Elastic-neutron-scattering measurements on the singlet-ground-state ferromagnets fcc Pr and Pr_3Tl are reported. Both exhibit magnetic phase transitions, possibly to a simple ferromagnetic state, at 20 and 11.6°K, respectively. The transitions appear to be of second order, although that in fcc Pr is clearly anomalous. Additional information on the inelastic scattering studies of the $\Gamma_1-\Gamma_4$ excitons in these systems is presented. dhcp Pr is also briefly discussed. (auth)

52270 PARAMAGNETIC BEHAVIOR OF SOME RARE EARTH–COBALT COMPOUNDS. Burzo, E. (Inst. for Atomic Physics, Bucharest). Phys. Rev., B; 6: No. 7, 2882-7(1 Oct 1972).

In the ferrimagnetic rare-earth cobalt compounds, the reciprocal susceptibility obeys a Néel-type law. As a function of rare-earth content, the paramagnetic moments of cobalt atoms vary similarly with those deduced from saturation measurements. For RCo_2 (R = Gd, Tb, Dy, Ho, or Er) compounds, the cobalt effective moment is $(2.00 \pm 0.50)\mu_B$, twice the value obtained in the ordered state. (auth)

52271 INDUCED-MOMENT SYSTEMS: PARAMAGNETIC REGION OF La_3Tl-Pr_3Tl. Bucher, E.; Maita, J. P.; Cooper, A. S. (Bell Labs., Murray Hill, N. J.). Phys. Rev., B; 6: No. 7, 2709-16(1 Oct 1972).

Superconducting and magnetic properties in the La_3Tl-Pr_3Tl system are discussed. Superconductivity persists up to very high Pr concentrations, Pr^{3+} being in a crystal-field-singlet ground state. The Van Vleck susceptibility per Pr^{3+} ion at $T = 0$ increases with increasing Pr concentration, indicating ferromagnetic exchange coupling between the Pr ions. At concentrations higher than 93 at. % Pr the system becomes ferromagnetic. No current theoretical model accounts for the observed magnetic behavior. (auth)

52272 MIGRATION EQUILIBRIUM OF AN ADSORBED CERIUM FILM ON A TUNGSTEN TIP IN AN INTENSE ELECTRIC FIELD. Palyukh, B. M.; Smereka, T. P. (Lvov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1725-7(Oct 1971). (In Russian).

The effect of an electric field on the equilibrium concentration of Ce atoms adsorbed on a point of a single crystal of tungsten was investigated. Heating the point increases the work function of the Ce–W system in the autoelectron field and decreases it in an autoionic field. The effect strongly depends on the extent of coverage, θ. The effect of the field is decreased with increasing θ. For a given θ, the effect is greater the higher the field intensity. For coverage $\theta > 1$, approximating a monatomic layer, the influence of the field is practically insignificant, perhaps due to a very small permanent dipole moment of Ce atoms adsorbed on the W. (tr-auth)

52273 GROUP THEORY AND ELEMENTARY ENERGY BAND THEORY CONCERNING RARE EARTHS. Petrakian, J. P. (Univ., Aix-Marseille). J. Phys. (Paris); 33: No. 2-3, 273-9(1972). (In French).

The energy band structure of solids is treated using group theory. Crystallographic considerations are used to define the crystal space group, which is associated to the group of the Schroedinger equation of quantum mechanics. The theory of group representations enables Bloch functions, the reciprocal lattice, and the first Brillouin zone to be introduced. The symmetry points and axes of this zone provide a framework for the energy diagram. This diagram is discussed in terms of the selection rules permitting the optical transitions. Most of the optical transitions for Gd are given. This element was studied optically in the form of thin films. A maximum optical absorbence was established for this element, a phenomenon which does not occur for light rare earths, which have a different crystal structure. It is shown that the presence of this peak at 3.1 eV can be interpreted satisfactorily in terms of this theory, the theoretical mean energy of the optical transitions of Gd being 3.06 eV. (France)

52274 MAGNETIC SUSCEPTIBILITY OF SOME ACTINIDE ALLOYS. Gatesoupe, Jean-Pierre; de Novion, Charles-Henri (CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. B; 274: No. 20, 1144-7(15 May 1972). (In French).

The magnetic susceptibility of certain alloys between actinides elements and the first transition elements are interpreted using a narrow band resonance model. It is shown that such a resonance can destroy a narrow density of states peak and disturb the properties linked with this density, if the Fermi level is situated on the peak. (France)

52275 ELECTRONIC PROPERTIES OF U CARBONITRIDES; $U(C_{1-x}N_x)$. de Novion, C. H. (CEN, Fontenay-aux-Roses, France); Costa, P. J. Phys. (Paris); 33: No. 2-3, 257-72). (In French).

The magnetic susceptibility (between 4 and 1000°K), specific heat (1.5 to 10°K), and electrical resistivity (4 and 1000°K) were measured for the solid solution $U(C_{1-x}N_x)$. Long-range antiferromagnetic order is only observed for $0.90 < x < 1$. There is, however, a possibility of short-range magnetic order for $0.50 < x < 0.90$. When $x < 0.50$, there is practically no localized magnetic moments. At the critical concentration, x_c approximately equal to 0.90, a maximum in the residual electrical resistivity, magnetic susceptibility, and electronic specific heat is observed. Numerical analysis of the magnetic susceptibilities indicates that each carbon atom suppresses the localized magnetic moments of its first six U neighbors. All of the results obtained can be quantitatively interpreted in terms of the 6d–5f band model with strong spin fluctuations. (France)

52276 NEGATIVE CONDUCTION-ELECTRON CONTRIBUTION TO THE FIELD GRADIENT IN BERYLLIUM. Mohapatra, N. C. (State Univ. of New York, Albany); Singal, C. M.; Das, T. P.; Jena, P. Phys. Rev. Lett.; 29: No. 8, 456-8(21 Aug 1972).

A first-principles calculation of the field gradient due to conduction electrons in Be leads to a contribution opposite in sign to that from ionic charges, in agreement with expectations from experiment. This result is of particular interest for the theory of nuclear quadrupole coupling constants in metals in view of recent experimental determinations of the sign of the latter. (auth)

52277 QUADRATIC FIELD DEPENDENCE OF ULTRASONIC ATTENUATION COEFFICIENT IN PARAMAGNETIC HOLMIUM. Tachiki, Masashi (Univ. of Wisconsin, Milwaukee); Lee, Mark C.; Levy, Moises. Phys. Rev. Lett.; 29: No. 8, 488-91(21 Aug 1972).

The ultrasonic attenuation coefficient α_k was measured in the paramagnetic phase of Ho in fields from 0 to 50 kG. α_k increased as the square of the field and decreased as the temperature increased. A model was developed which ascribes this increase in α_k to the interaction of the longitudinal phonons, via modulation of the exchange interaction, with the spin fluctuations associated with the virtual phase transition at the paramagnetic Curie temperature. This theory also agrees with the velocity data obtained by Moran and Lüthi. (auth)

52278 MAGNETIC PROPERTIES OF Ba_2FeUO_6. Bernier, J. C.; Grenet, J. C.; Poix, P. (Paris Univ., Orsay, France). J. Phys. Chem. Solids; 33: No. 9, 1819-25(Sep 1972). (In French).

After a short account of the preparation and the structure of the perovskite oxide Ba_2FeUO_6, the magnetic properties of this oxide are investigated. At high temperature, the magnetic susceptibilities follow a Néel law: $1/\chi = T/C + 27.7 - 12{,}570/T + 68$. Below the Néel point $\theta_N = 125°K$, a spontaneous magnetization appears: the magnetization saturation measurements give a magnetic moment of 4.08 μ_B. The Curie constant $C = 4.79$ and the saturation moment extrapolated to zero lead to the following proposed formula: $Ba_2[(Fe^{III})(U^V)]O_6$. A nearly total antiparallelism between the spin of uranium and iron in the two sites a and b in the magnetic ordered state is postulated. Discussion of the electronic configuration of the uranium U^V suggests the structure $5f^1$ as very probable with an orbital moment quenched in an oxygen octahedral coordination. (auth)

52279 MAGNETIC CHARACTERISTICS OF Ni–Fe–Nb ALLOYS. Masumoto, Hakaru; Murakami, Yuetsu; Hinai, Masakatsu (Research Inst. of Electric and Magnetic Alloys, Sendai). Trans. Jap. Inst. Metals; 13: No. 3, 182-5(May 1972).

Ni–Fe–Nb alloys composed of 72.98 ~ 84.67% Ni, 6.57 ~ 24.36% Fe, and 2.43 ~ 13.90% Nb were melted in air and reduced to ring-shaped specimens. The specimens were heated in pure hydrogen atmosphere at 1100°C for 3 h and then cooled at various rates. Measurements of their magnetic properties, electrical resistivity, and hardness indicated that the addition of niobium to Ni–Fe alloys brings about a great improvement in the characteristics of the alloys. The highest values of 42300 in initial permeability and 179,000 in maximum permeability were obtained when the alloy of 79.56% Ni, 12.04% Fe, and 8.40% Nb and the alloy of 79.62% Ni, 11.05% Fe, and 9.33% Nb were cooled from a temperature above the order–disorder transformation point at a rate of 240°C/hr, respectively. These alloys showed the coercive forces of 0.0107 and 0.0112Oe for the maximum magnetic induction of 5000G, respectively. The magnetic inductions of these alloys in the effective magnetic field of 1000Oe were found to be 6550 and 5690G, respectively. The electrical resistivity of the latter alloy was 69.5 $\mu\Omega$ cm, with the Vickers hardness of 215. (auth)

52280 MAGNETIC EXCITONS IN REAL SINGLET-GROUND-STATE FERROMAGNETS: APPLICATION TO Pr_3Tl AND FCC Pr. Cooper, Bernard R. (General Electric Research and Development Center, Schenectady, N. Y.). Phys. Rev., B; 6: No. 7, 2730-43(1 Oct 1972).

The magnetic-exciton behavior expected in cubic systems containing Pr^{3+} with a crystal-field-only Γ_1 singlet ground state was studied. The experimentally observed behavior in Pr_3Tl and fcc Pr is discussed. In particular, it is shown that crystal-field states lying higher than the Γ_4 first-excited triplet have an important qualitative effect on the magnetic-exciton dispersion relationship. The most important difference from the results for a singlet–triplet model is the appearance of a substantial gap at $\vec{q} = 0$ (~18°K in a typical realistic case) for the transverse excitons in the ferromagnetic state, while the gap for the longitudinal modes would also be much different if one neglected the higher-lying crystal-field states (~75% greater in a typical realistic case). The necessity of including effects of crystal-field states above the Γ_4 triplet led to the adoption of an effective boson (i.e., Bogoliubov-type) approximation valid only as the temperature approaches zero. Knowledge of the random-phase-approximation (RPA) results for the singlet–singlet problem is used to discuss the expected temperature dependence of the excitation spectrum. The existing theory, including the effects of all crystal-field levels, is quite successful in quantitatively predicting the experimental magnetic-exciton behavior at low temperature in Pr_3Tl. On the other hand, the existing theory offers no explanation for the absence of any measurable change with temperature of the measured dispersion relationship even when going to temperature well above the Curie temperature in Pr_3Tl and fcc Pr. The macroscopic magnetization variation with temperature in Pr_3Tl including all crystal-field levels in a molecular-field theory is treated. (auth)

52281 CRITICAL FIELDS IN DYSPROSIUM–COBALT COMPOUNDS. Taylor, K. N. R.; Primavesi, G. J. (Univ. of Durham, Eng.). J. Less-Common Metals; 29: 97-9(1972).

Studies were made on the compounds formed between Dy and Co, to the Dy-rich side of Dy_2Co_7. The materials studied (Dy_3Co, Dy_4Co_3, $DyCo_2$, and $DyCo_3$) were prepared by conventional argon arc melting techniques and subsequently annealed to improve the phase homogeneity. Magnetic measurements were made using a pulsed field magnetometer with a field rise time of approximately 1 msec. The magnetization curve at 4.2°K are given along with the variation of the critical field and ordering temperature. The results showed that the critical field behavior in the Dy–Co compounds may be attributed to the presence of narrow domain walls in the specimens, and that the critical field values are, in fact, the intrinsic coercivities of the compounds concerned. (P.C.H.)

Moessbauer Effects and NMR

52282 (FRNC-TH-208) STUDY BY PERTURBED ANGULAR CORRELATIONS OF A RARE EARTH IMPLANTED IN METALS. Bernas, Harry (Paris Univ., Orsay (France)). 1972. 99p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Magnetic and relaxation properties of Tm in Fe and noble metals were studied by observations of the integral perturbed angular correlations. Most of the experiments were performed in conditions under which the usual approximations of Abragam and Pound are not justified; the characteristics of the diluted impurity and the method used are described. In the case of Fe, the experiments were performed on two cascades having intermediate levels with different half-lives between 4.2 and 450°K. A strong anisotropic variation was observed as well as a rotation of the angular correlations; an explanation is given in terms of the paramagnetic-ion model with a fluctuating magnetic interaction, and a time correlation τ_0 in an exchange field, H_{ech}. The values obtained for the parameters of the model are as follows: $H_{ech} = 2.5 \pm 0.5$ MOe and $\tau_0(300°K) = 5 \times 10^{-12}$ sec. The variation of the hyperfine field with temperature is deduced from these parameters. (France)

52283 (ORNL-TM-3931) MOESSBAUER STUDIES OF ELECTROSTATIC HYPERFINE INTERACTIONS IN ^{238}U, ^{236}U, AND ^{234}U. Monard, Joyce Anne (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 97p. Dep. NTIS.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The nuclear gamma resonance for ^{238}U, ^{236}U, and ^{234}U in the compound $(UO_2)Rb(NO_3)_3$ was established at 4.2°K following the alpha decay of PuO_2 sources. The ratios of the electric quadrupole moments of these isotopes were determined and the electric field gradient at the uranium site was calculated from the data. The isomer shift in ^{234}U was measured for both PuO_2 and $PuAl_4$ sources and the change in nuclear radius between the excited and the ground state was calculated. (auth)

52284 STUDY OF RADIOACTIVE IMPURITIES IN SOLIDS. I. RADIATION CHARACTERISTICS. Hartmann-Boutron, F.; Spanjaard, D. (Univ. Paris, Orsay, France). J. Phys. (Paris); 33: No. 2-3, 285-97(1972).

The theoretical problem of the emission of radiation from radioactive nuclei is usually treated in a very general form adapted to nuclear physics. A considerably more specialized treatment is presented in view of adapting the results obtained to solid-state physics studies. A unified treatment of both perturbed angular correlations and nuclear orientation is given in such a way as to facilitate the comparison of these two types of experiment. The Fano formalism (multipole expansion of the density matrix) is used extensively in these investigations; this formalism is particularly useful for calculations on relaxation and radiofrequency effects. (France)

52285 TIME-DIFFERENTIAL PERTURBED ANGULAR CORRELATION ON ^{57}Fe IN Cu–Ni ALLOYS: MOESSBAUER DOUBLETS EXPLAINED. Reno, R. C.; Swartzendruber, L. J. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett.; 29: No. 11, 712-15(11 Sep 1972).

It is shown that when hyperfine interactions at ^{57}Fe nuclei are studied by both Moessbauer effect and time-differential perturbed angular correlations, information is obtained which is unavailable from either technique alone. In particular, previous ambiguities in the interpretation of ^{57}Fe Moessbauer spectra of Cu–Ni alloys are removed: The Moessbauer doublet is shown to be primarily due to a distribution of electric field gradients acting on the ^{57}Fe nuclei. (auth)

52286 NUCLEAR-RESONANCE INVESTIGATION OF A SCANDIUM–HYDROGEN SOLID SOLUTION. Weaver, H. T. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., B; 6: No. 7, 2544-6(1 Oct 1972).

Nuclear-magnetic-resonance measurements of spin–lattice relaxation time, Knight shift, and linewidths were made for ^{1}H and ^{45}Sc contained in $ScH_{0.37}$. Rigid-lattice proton linewidths indicate that the hydrogen is randomly located among two interstitial sites in hcp scandium. Both the spin–lattice relaxation rate and Knight shift for ^{45}Sc decrease relative to the values for scandium metal in such a manner that the Korringa product remains constant. Diffusion parameters are determined from the proton data. (auth)

52287 SPECTROGRAPHY FOR OBSERVATION OF THE STARK EFFECT ON THE NUCLEAR QUADRUPOLE RESONANCE OF ^{14}N. Colot, Jean-Louis (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 40: No. 3-4, 169-78(1971). (In French).

With a view to undertaking the study of the Stark effect on the nuclear quadrupole resonance of ^{14}N, an improved version of the usual spectrometer was developed. In order to obtain a significant increase in signal-to-noise ratio and in sensitivity, the spectrometer is built around a multichannel analyzer. The corresponding increase in observation time puts a strong demand upon the long-term stability, which is met by locking the spectrometer frequency to that of a quartz frequency standard. This frequency lock allows a linear electronic sweep of easily controllable speed and amplitude to be built in the spectrometer. (auth)

PHYSICS (THEORETICAL)

Refer also to abstracts 51512, 51860, 51880, and 52413.

52288 (LA-4992) GEOMETRIC INTERPRETATION OF THE DIRAC EQUATION. Aamodt, R. Lee (Los Alamos Scientific Lab., N. Mex.). Aug 1972. Contract W-7405-eng-36. 4p. Dep. NTIS.

In the space of special relativity, a Lorentz transformation and a rotation of the spatial axes through an imaginary angle generate two new coordinate systems in which a vector is described. The Dirac equation appears as a relation between the sums and differences of the components of the vector in the new coordinate systems. (auth)

52289 QUANTUM THEORY OF STATE REDUCTION AND MEASUREMENT. Fujiwara, Izuru (Univ. of Osaka Prefecture, Sakai, Japan). Found. Phys.; 2: No. 2-3, 83-110(Apr 1972).

The central problem in the quantum theory of measurement, how to describe the process of state reduction in terms of the quantum mechanical formalism, is solved on the basis of the relativity of quantal states, which implies that once the apparatus is detected in a well defined state, the object state must reduce to a corresponding one. This is a process termed by Schrödinger disentanglement. Here, it is essential to observe that Renninger's negative result does constitute an actual measurement process. From this point of view, Heisenberg's interpretation of his microscope experiment and the Einstein—Podolsky—Rosen arguments are reinvestigated. Satisfactory discussions are given for various experimental situations, such as the Stern—Gerlach-type experiment, successive measurements, macroscopic measurements, and Schrödinger's cat. Finally it is proposed to regard a state vector in quantum mechanics as an irreducible physical construct, in Margenau's sense, that is not further analyzable both mathematically and conceptually. (auth)

52290 MIND, MATTER, AND PHYSICISTS. Freundlich, Yehudah (Tel-Aviv Univ., Israel). Found. Phys.; 2: No. 2-3, 129-48(Apr 1972).

Some aspects of the problem of measurement in quantum theory are treated. It is stressed that the problem is both physical and conceptual, that the physical problem has been solved and the conceptual one is inherent in quantum theory. Some remarks made by Wigner concerning physics and the explanation of life are dealt with and alternative positions are presented on the mind-matter relation within a deterministic framework. (auth)

52291 SPECIAL CLASS OF SOLUTIONS OF THE SCHROEDINGER EQUATION FOR A FREE PARTICLE. Synge, J. L. (Inst. for Advanced Studies, Dublin). Found. Phys.; 2: No. 1, 35-40(Jan 1972).

The fundamental solution of the Schrödinger equation for a free particle is modified by the inclusion of an arbitrary scalar and an arbitrary vector, both imaginary. This gives a field free from singularities. By choosing the scalar small and the vector large, one obtains a model of a wavepacket which moves fast and remains concentrated over a long range. (auth)

52292 REINTERPRETATION OF VON NEUMANN'S THEORY OF MEASUREMENT. Moldauer, P. A. (Argonne National Lab., Ill.). Found. Phys.; 2: No. 1, 41-7(Jan 1972).

Von Neumann's theory of measurement in quantum mechanics is reinterpreted so that the experimental arrangement specifies the location of the "cut" by calling for the separate observation of the object and the measuring apparatus after the initial measurement interaction. The measurement ascertains which element of the mixture describing the final state of the apparatus is actually present. The relevance and feasibility of observing the final coherent state of the object plus apparatus is criticized and the paradoxes of "Schrödinger's cat" and "Wigner's friend" are discussed. (auth)

52293 MOTION OF WAVELETS: AN INTERPRETATION OF THE SCHROEDINGER EQUATION. Koga, Toyoki. Found. Phys.; 2: No. 1, 49-78(Jan 1972).

There are stable wavelets which satisfy the Schrödinger equation. The motion of a wavelet is determined by a set of ordinary differential equations. In a certain limit, a wavelet turns out to be the known representation of a classical material point. A de Broglie wave is constructed by superposing similar free wavelets. Conventional energy eigensolutions of the Schrödinger equation can be interpreted as ensembles of wavelets. If the dynamics of wavelets form the quantum mechanical counterpart of Newton's dynamics of particles, then conventional quantum mechanics is the counterpart of Gibbs's mechanics of ensembles. In this way, conventional quantum mechanics is reinterpreted on a deterministic basis. A difficulty of quantum field theory is predictable from this point of view. (auth)

52294 COMPLEX TIME, CONTOUR INDEPENDENT PATH INTEGRALS, AND BARRIER PENETRATION. McLaughlin, David W. (New York Univ., N. Y.). J. Math. Phys. (N. Y.); 13: No. 8, 1099-1108(Aug 1972).

By developing an analogy between the Feynman path integral and contour integral representations of the special functions, one obtains WKB formulas for barrier penetration from a path integral. It is first shown that there exists for the path integral a notion of contour independence in the time parameter. Then an appropriate contour is selected to describe the physical situation of barrier penetration, and asymptotic formulas are obtained from the function space integral. The method is interpreted as a path integral derivation of the complex ray description of barrier penetration. Several canonical problems of the theory of complex rays with these path integral techniques are investigated. (auth)

52295 ANALYTIC APPROXIMATION METHOD FOR THE ONE-DIMENSIONAL SCHROEDINGER EQUATION. I. Hecht, W. (Univ., Freiburg B.). J. Math. Phys. (N. Y.); 13: No. 8, 1291-4(Aug 1972).

A mathematical method for approximating the solutions of the one-dimensional Schrödinger equation is suggested which leads to a classification scheme identical to that of "classical turning points." Problems with at most two classical turning points are studied. Physical examples are chosen in such a way as to clarify especially the role of complex conjugate turning points and of others which do not belong to the physical region of the position variable. It is shown that, in general, those turning points must be taken into account and can be neglected only if their distances from the physical region of the position variable, as measured in units of a local wavelength, is large. (auth)

52296 O(2, 1) x O(3) SOLUTION TO A GENERALIZED QUANTUM MECHANICAL KEPLER PROBLEM. Cunningham, M. J. (Univ. of Canterbury, Christchurch, N. Z.). J. Math. Phys. (N. Y.); 13: No. 8, 1108-12(Aug 1972).

A differential equation directly related to the generalized Kepler equation of Infeld and Hull is solved in an O(2,1) × O(3) group scheme. This equation contains as special cases the Schrödinger, Klein—Gordon, and Dirac (two forms) hydrogen atoms. A generalized Pasternack and Sternheimer selection rule exists and some matrix elements can be evaluated group theoretically. (auth)

52297 PRINCIPLE OF OBSERVABILITY IN MODERN PHYSICS. Omelianovskii, M. E. (Inst. of Philosphy, Moscow). Found. Phys.; 2: No. 2-3, 223-39(Apr 1972).

Some epistemological and methodological problems associated with the principle of observability are discussed, especially in relation to this principle's heuristic role and its objective basis and in relation to the philosophical doctrine of Mach. (auth)

52298 MULTIGROUP TRANSPORT THEORY WITH A DEGENERATE TRANSFER KERNEL. Silvennoinen, Pekka; Zweifel, P. F. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Math. Phys. (N. Y.); 13: No. 8, 1114-17 (Aug 1972).

The multigroup transport equation is studied in plane geometry assuming that the transfer kernel is representable in a degenerate form. The eigenvalue spectrum is analyzed and the associated eigensolutions are obtained in terms of generalized functions. Full-range orthogonality relation is demonstrated. The full-range completeness of the eigensolutions is established under rather general conditions. For the half-range completeness to hold, it is additionally required that the scattering kernel be self-adjoint and possess reflection symmetry. (auth)

52299 INITIAL STATIONARITY OF QUANTUM-MECHANICAL STATES. Hack, M. N. Phys. Lett.; 40A: No. 5, 351-2(14 Aug 1972).

Initial stationarity is established for a broad class of states and a criterion for stationary states derived. (auth)

52300 BOHM—VIGIER SUBQUANTUM FLUCTUATIONS AND NONLINEAR FIELD THEORY. Rybakov, Yu. P. (Institut Henri Poincare, Paris). Int. J. Theor. Phys.; 5: No. 2, 131-8(1972).

Utilizing as a starting point the double solution theory of Louis de Broglie and the Bohm—Vigier hypothesis of subquantum fluctuations, an attempt is made to give an example of the nonlinear field theory in which the "guidance" theorem of de Broglie can be realized. The simplest scalar model is considered. (auth)

52301 QUANTUM SYSTEMS IN THERMAL CONTACT. Roos, H. (Univ., Goettingen, Ger.). Commun. Math. Phys.; 26: No. 2, 149-68(1972).

It is shown that under rather general conditions two K.M.S. states ω_1 and ω_2 of systems S_1 and S_2, respectively, can be simultaneously extended to a K.M.S. state ω of a system composed of S_1 and S_2, provided both systems have equal temperatures. This result gives further support to the conjecture that K.M.S. states are equilibrium states. A model of thermal coupling is constructed which satisfies the assumptions of the first part, thereby showing that the result is also valid in the interesting case of systems S_1 and S_2 in thermal contact. (auth)

52302 QUANTUM KINEMATICS AND DYNAMICS. Schwinger, Julian. Frontiers in Physics. New York; W. A. Benjamin, Inc. (1970). 385p.

The algebra of measurement, geometry of states, the dynamical principle, the special canonical group, canonical transformations, groups of transformations, canonical transformation functions, Green functions, and some applications and further developments are treated. (J.F.P.)

52303 NEW THEORY OF ELEMENTARY MATTER. PART III. A SELF-CONSISTENT FIELD THEORY OF ELECTRODYNAMICS AND CORRESPONDENCE WITH QUANTUM MECHANICS. Sachs, Mendel (State Univ. of New York, Buffalo). Int. J. Theor. Phys.; 5: No. 1, 35-53(1972).

The axioms and general mathematical structure of a new theory of elementary matter, thus far developed in two earlier papers (Sachs, Internat. J. Theor. Phys. 4: No. 6, 111 (1971) are exploited. It is shown in an explicit fashion, how the exact form of this theory approaches that of quantum mechanics of a "many-particle" system that interacts electromagnetically. The form of the mathematical expression of quantum mechanics of a many-particle system is found to be a linear approximation for the nonlinear (deterministic) field theory of the approach. The latter approximation is valid only when the components of the closed system are sufficiently weakly coupled so that it appears as a many-particle system. The physical equivalent of the Pauli exclusion principle is derived as an exact feature of the theory, which is, in fact, sensitive to its closed and nonlinear features. It is then shown how the Fermi–Dirac statistics in particle physics follow from the present nonlinear theory only in a linear approximation. (auth)

52304 REMARKS ABOUT SINGLE PARTICLE SCHROEDINGER EQUATIONS. Cawley, Robert G. (Naval Ordnance Lab., Silver Spring, Md.). Int. J. Theor. Phys.; 5: No. 2, 123-5(1972).

Formal quantization of noumenal and observer canonical formalisms and the relationship between the two are discussed. (auth)

52305 CURRENT DENSITY IN RELATIVISTIC QUANTUM MECHANICS. Marx, Egon (Drexel Univ., Philadelphia). Int. J. Theor. Phys.; 5: No. 3, 151-9(1972).

The concepts of probability density and probability current density of nonrelativistic quantum mechanics are extended to relativistic theories, together with the charge and current densities that are used as sources of the electromagnetic field in the semi-classical theory of radiation. There are some limitations in the procedure, especially in the case of several particles. (auth)

52306 NUMERICAL ACCURACY OF THE REGULAR COULOMB FUNCTION. Carstoiu, B. (Inst. of Atomic Physics, Bucharest); Deberth, C.; Hategan, C.; Sandulescu, A. Rev. Roum. Phys.; 17: No. 2, 113-20(1972).

A FORTRAN IV subroutine for the regular Coulomb function $F_l(\eta,\rho)$ and its derivative $(dF_l(\eta,\rho)/d\rho)$ based on the well known power series expansion of this function is presented. A study of the number of lost significative digits is made as a function of η, l and ρ. The results, presented in 9 tables, for $\eta = 1(3)25$, $l = 0(5)50$ and $\rho = 5(5)50$ show that the number of lost significative digits decreases as l and η increase and increases with the increase of ρ. (auth)

52307 THEORY OF ISOTOPE SHIFTS. Broch, E. K. (Univ. of Oslo). Phys. Norv.; 5: No. 3-4, 253-7(1971).

An attempt was made to discuss the appropriate solutions of Dirac's relativistic wave equations, which are principal when studying isotope field shifts. The limitations of perturbation treatment lead to evaluations of the shifts by more rigorous methods. The essential features of the shifts can be expressed as the product of two factors, one associated with the electron configuration and one with specifically nuclear properties. (auth)

52308 MEASUREMENT AND QUANTUM-MECHANICAL FORMALISM. Staricek, Imrich Frantisek (Slovak Academy of Sciences, Bratislava). Cesk. Cas. Fys.; 22: No. 4, 366-76 (1972). (In Czech).

An analysis of the quantum mechanical model of measurement as developed by Daneri, Loinger and Prosperi is presented. The model fails to consistently meet the postulate of Bohr, that the result of each microphysical measurement is macrophysical data read on measuring instruments, the function of which can in principle be described in terms of classical physics. Measurement is a gnoseological process that cannot be reduced to an interaction of two physical systems. The result of each microphysical measurement is always a statistical set of data measured in a classical and interpreted in a quantum mechanical way. The classical and the quantum mechanic-statistical description cannot be expressed by the help of a single theoretical system. The quantum mechanical description of a macrophysical system assumes a phenomenological interpretation of the quantum mechanical formalism. A more profound analysis of the measuring process, especially of the ergodic transition from the statistics of microevents to the phenomenology of macroevents may contribute to the explanation of the relations between the two interpretations of quantum mechanical formalism: the phenomenological and the statistical. (auth)

52309 CONCEPTUAL FOUNDATIONS OF QUANTUM MECHANICS. Eisenbud, Leonard. Van Nostrand Reinhold Momentum Books. New York; Van Nostrand Reinhold Company (1971). 159p. $3.95.

The topics cover the failure of classical theory, consequences of a mistrust of theory, DeBroglie relations for properties of electrons and photons, an analysis of electron diffraction, the Heisenberg principle of indeterminacy, interpretations of the Heisenberg principle, dynamical properties of microsystems, determinism and state, statistical determinism, probability amplitudes, and the superposition principle. (J.F.P.)

52310 ASYMPTOTIC EXPANSION FOR EIGENVALUE DENSITY. Siemens, Ph. J.; Sobiczewski, A. (Univ. of Copenhagen). Phys. Lett.; 41B: No. 1, 16-18(4 Sep 1972).

The density of eigenvalues of a potential well is calculated in an asymptotic expansion for large geometrical size. Explicit, readily calculable expressions are obtained for volume and surface contributions. The resulting expressions are numerically applied to the case of a spherical Woods–Saxon well. (auth)

52311 THEORY OF FERMION FIELD WITH ZERO MASS. Smirnov, L. I. (Leningrad Electrical Engineering Inst. of Communications). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 7-12 (1970). (In Russian).

The theory of the free fermion field with spin $\frac{1}{2}$ and zero mass is constructed on the basis of the equation $(d + a\gamma_5 - b)\psi(x) = 0$, where $a^2 = b^2 = 1$. The theory is invariant relative to the continuous Lorentz transformations. It is also invariant relative to combined Landau reflection, time inversions, and the strong inversion of Schwinger space–time, but not invariant relative to spatial reflection in charge transformation. In the theory discussed, the appearance of projectors is essential. They emerge because of the presence null divisor in the mass member of the equation and enter into the conditions of normalization of solutions of the equation and, consequently, in all conservation operators and their intrinsic functions. (tr-auth)

52312 INTEGRATION OF THE KINETIC EQUATION FOR A QUANTUM FUNCTION OF WIGNER'S DISTRIBUTION. Gorshenkov, V. N.; Kon'kov, V. L. (Gorky Scientific-Research Physical-Technical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 167-9(1972). (In Russian).

A quantum distribution function was first expressed as a kinetic equation by Wigner. It was subsequently integrated for the case of an equilibrium system. The present authors sought to find the quantum distribution function for a system of electrons in a constant magnetic field and spatially localized potential. (K.S.W.)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstracts 50370, 50724, and 52615.

52313 (DP-Report-567) COMPARISON OF CARBON-ATOM DISPLACEMENT RATE IN GRAPHITE IN THE DRAGON REACTOR, THE PETTEN HFR, AND OTHER REACTORS. Project DRAGON. Reed, D. L. (Atomic Energy Establishment, Winfrith (England)). Aug 1968. 42p. Dep. NTIS (U. S. Sales Only).

A revision of Monte-Carlo calculations was made and the ratio of the carbon-atom displacement rate per unit nickel fission flux in the Dragon capsule in Petten to that in the TE.10 hole in BEPO was found to be 0.49 as compared to the experimental value of 0.52. This result together with results reported for other reactor systems gives confidence in using the Monte-Carlo method for obtaining the ratio of carbon-atom displacement rate per unit nickel fission flux from one reactor to another. Calculations were therefore made using this method to relate the carbon-atom displacement rate per unit nickel fission flux in Dragon and a number of proposed HTR's with that in a DIDO Mk. III fuel element. These calculations were then used to give the DIDO nickel dose obtained in Dragon, and the proposed HTR's after a period of 300 days. It was found that the average DIDO nickel dose across a cell of a reactor was proportional to the power density for the reactor systems considered. 11 references. (auth)

52314 (INIS-mf-243) ANNUAL REPORT, 1970. (Aktiebolaget Atomenergi, Studsvik (Sweden)). [nd]. 15p. INIS.

The annual report for 1970 by the board and the managing director of AB Atomenergi is presented. Market development in nuclear energy during 1970 is discussed. Research and development work on light-water-cooled reactors and their fuels was the main task of the company. At the end of the year the number of employees was 1100. (INIS)

52315 (JAERI-Memo-4048) SUMMARY OF TECHNICAL REPORTS ON THE 2nd MITI DESIGN PERMIT OF JPDR-II. (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. 134p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The request for the second construction permit of the improved JPDR-II was submitted on April 6, 1970 and was obtained on May 29, 1970. Technical memoranda are presented in support of the request. The subjects covered by the 18 technical memoranda and 2 appended articles include: the air exchange system for the reactor containment vessel, air-flow instrumentation, flow rate of the exhaust gas stream, specifications for air entering the filter system of the emergency air exchange unit, special features of the radioactive iodine filter system, testing of the emergency air exchange filter system, specifications for valves as indicated in the construction permit demand, distribution lines from the primary steam control valve; pressure changes within the reactor, shielding calculations related to the containment shell, dehumidification of the exhausted air, seismic calculations concerning the new primary steam lines, and determination of the replacement periods of the activated carbon filters for the emergency air exchange system. (TTT)

52316 (R-890(RAND)) EXPLORATION OF THE PERFORMANCE OF MULTIPHASE NUCLEAR-FUEL CAVITY REACTORS FOR POWER GENERATION. Pinkel, B.; Gritton, E. C. (RAND Corp., Santa Monica, Calif.). Apr 1972. 62p.

An exploratory study of the cavity reactor with the fissile material in the solid, the liquid, the solid-liquid, the solid-liquid-gas, and the liquid-gas states was made in a search for attractive operational regimes. This investigation of the effect of fuel state was centered largely about a reference reactor design having a molybdenum spherical shell with a cavity of 5-ft radius containing ^{235}U as the fissile material and cooled by liquid lithium. However, the sensitivity of the results to variations in the reactor parameters from this reference reactor design and to changes in fissile material and cavity wall material was also investigated. Where the values of the physical constants were uncertain, the effect on performance of a variation in these values over the range of uncertainty was determined. (26 references) (auth)

52317 (RDT-INDEX-7-72) INDEX OF RDT STANDARDS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1972. 25p. RSO.

An index is presented for 237 RDT Standards issued through July 31, 1972. (H.D.R.)

52318 (RDT-STATUS-7-72) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of July 31, 1972. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 9 Aug 1972. 45p. RSO.

The historical status and schedule for preparation of Reactor Development and Technology standards are tabulated. (H.D.R.)

52319 (WARD-3045-T-2-C-2) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending May 31, 1972. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug 1972. Contract AT(11-1)-3045. 61p. Dep. NTIS.

FAST TEST REACTOR—cooling system for, structural testing of pipes and pipe fittings for, (E/T)
LIQUID METAL FAST BREEDER REACTOR—core structures for, high temperature design criteria for, (E/T)
—cooling system for, structural testing of pipes and pipe fittings for, (E/T)
PIPE FITTINGS—structural testing of stainless steel, for sodium cooled reactor systems, (E/T)
PIPES—structural testing of stainless steel, for sodium cooled reactor systems, (E/T)
STAINLESS STEEL—strain behavior of Types 304 and 316, effects of stress distribution on high temperature, (E/T)
—elastic behavior of Types 304 and 316, effects of stress distribution on high temperature, (E/T) (H.D.R.)

52320 ECONOMIC PROSPECTS OF NUCLEAR POWER PLANTS. Biro, Zoltan; Pikler, Ferenc. Energ. Atomtech.; 23: No. 9, 423-31(Sep 1970). (In Hungarian).

At the conference held by the International Atomic Energy Agency in October 1969 this topic was thoroughly discussed. The official positions of 5 highly industrialized countries as well as 5 developing countries are presented. (auth)

52321 KERNKRAFT HEUTE UND MORGEN. KERNFORSCHUNG UND KERNTECHNIK ALS CHANCE UNSERER ZEIT. (Nuclear Power Today and Tomorrow. Nuclear Research and Nuclear Technique as the Chances of Our Time). Gerwin, Robert. Stuttgart; Deutsche Verlags-Anstalt GmbH (1971). 138p.

Information is presented in tables, schemes, and numerous color pictures. The content is internationally oriented with respect to present status and future outlook. Details are given for development in West Germany. The publication represents a contribution to the 1971 Geneva Conference. Economics, light-water reactors, the next generation of nuclear power plants, risks and environmental protection, nuclear energy use for other purposes than electricity production, worldwide energy demands, and the German atomic program are discussed. (H.B.G.)

52322 STATE OF DEVELOPMENT OF NUCLEAR ENERGY. Wirtz, K. (Deutsche Nationale Komitee der Weltenergiekonferenz, Mannheim, Ger.). Brennst.-Waerme-Kraft; 24: No. 7, 276-9(Jul 1972). (In German).

There lie ahead further quantitative problems and a qualitative change of position. Possible effects on the environment, interaction with other disciplines, investigations of safety aspects, and questions of acceptibility have occupied the safety committees. In the area of technical development, the gas-cooled high-temperature reactor and the light-water reactor are considered. Fast sodium-cooled breeder reactor safety aspects are discussed. 14 references. (auth)

52323 LIGHT-WATER NUCLEAR PLANTS IN THE COMMUNITY: THE PRESENT POSITION AND DEVELOPMENT PROSPECTS. Barazzoni, Luigi; Colling, Armand; Ehrentreich, Joachim; Nacfaire, Hubert; Siebker, Manfred. Euro-Spectra; 11: No. 1, 12-23(Mar 1972).

The development of the design of light-water nuclear power stations is reviewed and future prospects considered. Size and standardization, performance, design, fuel and fuel cycle, plant operating experience, chief problems, and economic aspects are discussed. (M.C.G.)

52324 NUCLEAR ENERGY IN ELECTRICITY SUPPLY IN THE USA. Kroms, Antons (Manton-Gaulin Mfg. Co., Everett, Mass.). At. Strom; 18: No. 3-4, 50-8(Mar-Apr 1972). (In German).

The application of nuclear energy as an energy source is considered. The state achieved, the most important problems, and the foreseeable development of nuclear energy utilization in electricity supply in the USA is explained. (auth)

52325 OPERATIONAL EXPERIENCE WITH NUCLEAR POWER INSTALLATIONS IN THE FEDERAL REPUBLIC OF GERMANY. At. Strom; 18: No. 5-6, 73-88(1972). (In German).
A comprehensive review is given of operational results achieved with the nuclear power stations functioning in the Federal Republic of Germany during 1971. (auth)

Physics and Core Engineering

52326 (AEEW-M-1084) QUANTITATIVE ASSESSMENT OF DYNAMIC MODELS BY COMPARISON WITH PLANT RESPONSE DATA. Gall, C. J. (Atomic Energy Establishment, Winfrith (England)). Feb 1972. 13p. Dep. NTIS (U. S. Sales Only).
A method is proposed for the quantitative assessment of mathematical dynamic models by comparison with plant transient response data. The method is applicable to models intended for stability and control system studies. The theory is based on the fact that the frequency responses of such models need to match the frequency response of the plant near the Nyquist stability point whereas the matching for frequencies tending to zero and infinity is less important. From this basis a transformation to the time domain enables the comparison to be carried out conveniently using transient responses. (auth)

52327 (AEEW-R-784) FURTHER APPLICATIONS OF FIRST-ORDER PERTURBATION THEORY TO THE CALCULATION OF REACTIVITY COEFFICIENTS IN SGHWR's. Siudek, R. S. (Atomic Energy Establishment, Winfrith (England)). Feb 1972. 16p. Dep. NTIS (U. S. Sales Only).
The methods of first-order perturbation theory, previously developed for the calculation of fuel-temperature reactivity coefficients in SGHWR's, are extended to enable the calculation of the reactivity changes associated with a change of boron-10 concentration dissolved in the moderator, and a change in extrapolated core height. The former reactivity change is shown to be in good agreement with that calculated by conventional methods, whereas the latter is in rather poor agreement. This discrepancy is shown to be a consequence of the assumption of a zero flux perturbation, and a suggestion is given for improving the agreement. (auth)

52328 (AEG-E3-1883(Pt.1)) SODIUM-COOLED HIGH-ENERGY LEVEL BREEDER REACTOR. REFERENCE STUDY. Amon, F.; Lill, G.; Tischer, G.; Uhde, W. (comps.) (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Grosswelzheim (West Germany)). Apr 1971. vp. (In German). INIS.
Development work carried out by AEG-Telefunken over the years 1969 and 1970 is described and all the technical, physical, and economic aspects important for the design are covered. The major items of Vol. 1 are: the reactor and its components, reactor physics, the plant as a whole, dynamics and safety of the reference design, as well as a cost analysis (fuel cycle, plant and current costs). (INIS)

52329 (CISE-R-199) ETA BETA 2: A ONE-DIMENSION MULTI-REGION TWO GROUP DIFFUSION CODE FOR LONG-TERM REACTIVITY CALCULATIONS. Bruschi, C.; Foresti, G.; Pierini, G.; Rubbia, S. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1966. 83p. INIS.
Declassified 1971.
The digital program ETA BETA 2, devised for studying the long-term behavior of a thermal reactor under neutron irradiation, is described. The code deals with one-dimensional two-group neutron diffusion in cylindrical geometry, while a constant and uniform buckling accounts for the axial leakage of neutrons. The reactor core is divided into a finite number of regions and the time evolution of their properties is calculated by considering region averaged fluxes at discrete values of the time variable. A two-zone (fuel and moderator) model is used for the lattice calculation, which is performed according to a three-group formalism; the two-group parameters follow when the two epithermal groups are collapsed together. The analytical method used in solving the diffusion equations allows for linear variations with respect to the control parameter in all of the two-group macroscopic coefficients. Therefore, besides the conventional controlling scheme, based on the dilution of an absorbing nuclide (typically boron) throughout the moderator, the reactivity can also be controlled by a reduction in the moderator density. Another interesting feature of the code, made possible by the same method, consists in the possibility of simply obtaining a flat flux in a central zone of the core. Moreover the code is able to put into such a flattened flux zone the largest number of radial regions the core has been divided into, which makes a critical configuration possible. The code also performs iterations in order to adjust the xenon concentration and coolant density in accordance with the flux distribution. (INIS)

52330 (CISE-R-208) HEAT TRANSFER CRISIS AND PRESSURE DROP WITH STEAM-WATER MIXTURES: FURTHER EXPERIMENTAL DATA WITH SEVEN ROD BUNDLES. Gaspari, G. P.; Hassid, A.; Ravetta, R.; Rubiera, L. (Centro Informazioni Studi Esperienze, Milan (Italy)). Mar 1968. 16p. INIS.
Declassified 1971.
Experimental data obtained at CISE under the CIRENE-3 Program on heat transfer crisis and pressure drop with vertical upward flow of steam-water mixtures in seven rod bundles are presented. The experiments were carried out under the following conditions: geometry, seven rod bundles; rod diameter, 1.8 cm; rod-rod and rod-pressure tube spacing, 0.138 cm; "grid" and "plate" spacers heated length, 160 cm; specific mass flow rate, $40 \div 300$ g/cm^2 s; inlet steam quality (by weight), $-0.25 \div +0.50$ (subcooling from $70 \div 80$°C); pressure, 30 to 60 kg/cm^2. 218 experimental points of heat transfer crisis are presented as well as about 50 points of pressure drop with heat transfer conditions. A brief description of the test element design and a presentation of results are also given. (INIS)

52331 (JAERI-M-4660) SHIELDING FACTORS OF CAPTURE CROSS-SECTIONS WITH TEMPERATURE DEPENDENCE FOR Cr, Fe, AND Ni. Ishiguro, Yukio (Japan Atomic Energy Research Inst., Tokyo). Dec 1971. 30p. NTIS (U. S. Sales Only).
The Doppler effect due to fast reactor structural materials is examined. For the purpose of the analysis of the Doppler effect, the self-shielding factors of capture cross-sections with temperature dependence are calculated for the natural Cr, Fe and Ni in the form of the ABBN and JAERI Fast group constant sets. Using these shielding factors, the Doppler experiments for stainless steel and natural iron performed in the FCA core are analyzed by a simple perturbation method. (auth)

52332 (JAERI-M-4696) EXPERIMENTS AND CALCULATION OF β_{eff}/l FOR THE LIGHT-WATER MODERATED TWO-REGION CORE OF UO_2 AND PuO_2–UO_2 LATTICES. Tsuruta, Harumichi; Kitamoto, Koichi (Japan Atomic Energy Research Inst., Tokyo). Feb 1972. 56p. (In Japanese). NTIS (U. S. Sales Only).
When substituting PuO_2-UO_2 for the UO_2 fuel in a power reactor, the reactivity coefficient, power distribution, and changes in the kinetic parameters must be taken into consideration. Experiments were made to obtain information on the kinetic parameters, effective delayed-neutron fraction β_{eff} and prompt neutron lifetime l, for the plutonium-fueled lattices. For the purpose, β_{eff}/l were measured by the pulsed-neutron technique. The two-region cores consisting of the PuO_2-UO_2 and UO_2 lattices were studied; and also the core of UO_2 lattices for comparison. An analytical correlation with the theoretical values was made in some cases. The values of β_{eff} and l were calculated by means of the perturbation theory. The calculated results of effective multiplication factor and β_{eff}/l are in good agreement with the experimental ones. By substitution of plutonium for the uranium fuel, β_{eff} is reduced. In varying l, however, β_{eff}/l for the PuO_2-UO_2 lattice becomes larger occasionally than for the UO_2 lattice. (auth)

52333 (JAERI-Memo-3966) EFFECT OF PHOTO-NEUTRON ON β OF PRESSURE TUBE TYPE DEUTERIUM WATER REACTOR. II. Kaneko, Yoshihiko; Akino, Fujiyoshi; Kurokawa, Ryosuke (Japan Atomic Energy Research Inst., Tokyo). Apr 1970. (In Japanese). NTIS (U. S. Sales Only).
A theoretical investigation by use of the collision probability method is made on the effect of photo-neutrons on β of a pressure tube type deuterium water reactor. It is concluded that a shielding effect of cluster fuels for the hard gamma rays emitted from fission products reduces the contribution of the photo-neutrons on β from 0.100 of the widely used value to 0.022. (auth)

52334 (LAMS-2839) PILOT MODEL. INDUCTION HEATED ROTATING FLUIDIZED BED. Giles, Paul M. (Los Alamos Scientific Lab., N. Mex.). Jan 1963. Contract W-7405-eng-36. 14p. Dep. NTIS.
VHF induction heaters were applied to metallic particle heating in specific rotating fluidized bed application, conforming to the nuclear reactor concept. Motion picture documentation demonstrates a working pilot model. (auth)

52335 (RD/B/N-2217) PHYSICS MEASUREMENTS ON AN AXIALLY AND RADIALLY NONUNIFORM CAGR SIMULATION. Beynon, A. J.; Kitching, S. J.; Lewis, T. A.; Roberts, D. A. (Central Electricity Generating Board, Berkeley (England). Berkeley

Nuclear Labs.). May 1972. 65p. (RPC/RPNK/P-(72)24). Dep. NTIS (U. S. Sales Only).

The detailed understanding of CAGR performance evaluation codes evolved to the stage of requiring a complex radial and axial fuel and absorber loading to complete the testing program. This was incorporated in the last of a series of reactor builds which were used to investigate reactivity, power distribution and early reactor life burnup characteristics. Manganese ^{235}U, ^{238}U, Pu and ^{103}Rh reaction rate distributions were measured in a reactor with varying axial and radial fuel loading, both unperturbed and including part inserted control rods. The worth of these absorbers and the reactivity of the unperturbed stack were also measured by critical and subcritical techniques. Details of the reasons for the measurements, the techniques used, and the results are given with full descriptions of new experimental developments. (auth)

52336 REACTOR STRATEGY: FBR'S AND HTGR'S. Fortescue, Peter (Gulf General Atomic, Inc., San Diego, Calif.). Nucl. News; 15: No. 4, 36-9(Apr 1972).

Three areas of gas reactor technology, the HTGR, the GCFR, and the gas turbine, are considered and attention drawn to the benefits from concurrent deployment of all these developments in the power generation field. Capital costs, environmental factors, ^{233}U availability, and the view of fast breeders and advanced converters as supplementary techniques are considered. (M.C.G.)

52337 BRITAIN'S PROTOTYPE FAST REACTOR: FOCAL POINT OF THE BREEDER DEVELOPMENT PROGRAM. Rippon, Simon (Nuclear Engineering International, London). Elec. Light Power (Boston); 50: No. 5, 37-44(Mar 1972).

The UK 250 MW(e) Prototype Fast Reactor (PFR) is described. The core consists of 78 hexagonal flue subassemblies arranged in groups of 6 around a void position that contains a leaning post and, where applicable, a control rod. The fuel pins contain mixed oxide pellets. The liquid sodium primary coolant flows upward through the fuel assemblies and in the process the sodium temperature is raised from 752 to 1040°F. The secondary sodium from pairs of intermediate heat exchangers is circulated through three loops each coupled to the steam raising plant with a capacity of 200 MW. The target for PFR fuel is 7.5% burnup of all initial heavy atoms (uranium and plutonium), which is roughly equivalent to 61,000 MWd/t. Development of a commercial fast breeder and comparisons with development programs in other countries are considered. (M.C.G.)

52338 FAST BREEDER REACTOR. Lang, Linton W. (to United States Atomic Energy Commission). U. S. Patent 3,658,644. 25 Apr 1972. Filed 6 Feb 1970.

A fast breeder reactor consists of a core, an inner blanket consisting of a single ring of blanket elements surrounding the core, an outer blanket surrounding the inner blanket and a partition containing a moderating material, and preferably a material which absorbs thermal neutrons separating the inner blanket from the outer blanket. Lithium can be used as both the moderating and absorbing material, tritium being formed therein as a useful byproduct. (Official Gazette)

52339 SHROUD FOR A FUEL ASSEMBLY IN A NUCLEAR REACTOR. Sauar, Tor Ole (to Institutt for Atomenergi). U. S. Patent 3,663,366. 16 May 1972. Priority date 6 Apr 1969, Norway.

In nuclear reactors utilizing water both as moderator and coolant, shrouds are frequency applied for the direction and confinement of the coolant flow along the fuel element. In a reactor according to the invention, however, said shrouds also serve another purpose, namely to provide the reactor core with burnable poison, which will advantageously modify the operation of the reactor in several ways. According to the invention it is considered convenient to disperse boron poison in sheets of stainless steel, which form an internal layer of a zirconium alloy. Said shroud will then be constructed from such compound plates. (Official Gazette)

52340 COLLECTING DEVICE FOR COOLING REACTOR CORE FRAGMENTS IN A FAST BREEDER REACTOR. Schabert, Hans-Peter (to Siemens Aktiengesellschaft). U. S. Patent 3,677,892. 18 Jul 1972. Priority date 14 May 1968, Germany.

A device for cooling core fragments in a gas-cooled fast breeder reactor is described which will assure reliable cooling of the fragments at all times. In addition to the main coolant flow downward through the collecting device, an auxiliary coolant is passed in a separate circulatory flow. (D.L.C.)

52341 REACTOR CONTAINING SEVERAL PARALLEL ARRANGED PIPE SECTIONS BEARING FISSIONABLE FUEL. Rolf-Woeltje. German Patent 1,464,632. 5 Jan 1972. (In German).

A description is given of a variant of the pressure-tube reactor, mainly characterized by pipe sections arranged in parallel which bear the fuel, with the moderator liquid used as a coolant flowing through these sections, circulated by pressure between reactor core and heat exchanger. The moderator liquid wets only the inside walls of the pipe sections. The connecting cavities which remain between the pipe sections are completely filled with gas. (GF)

Control and Instrumentation

Refer also to abstracts 50644 and 50732.

52342 (ANL/EBR-56) EVALUATION AND PROPOSED MODIFICATION OF CANBERRA INDUSTRIES, INC., EQUIPMENT FOR NEUTRON MONITORING IN EBR-II. Moon, R. D.; Napper, D. H.; Moriarty, K. J. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Sep 1971. Contract W-31-109-eng-38. 43p. Dep. NTIS.

Equipment from Canberra Industries, Inc., was the first of its kind received for application to the plant protection system (PPS) of EBR-II; therefore, the components were thoroughly tested before acceptance for this application. The testing performed, circuit-design problems identified, and corrective action taken before installation of the equipment are described. (auth)

52343 (CEA-R-4357) USE OF A SAFETY MARGIN COMPUTER FOR THE CONTROL OF A NUCLEAR POWER PLANT. Douet, Paul; Jover, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jul 1972. 23p. (In French). Dep. NTIS (U. S. Sales Only).

The way to calculate the safety margin of a nuclear reactor is given. The automatic control and safety system of RHF (Institute Laüe-Langevin, Grenoble), which is using a safety margin analog computer, is described. The results of tests on a simulator and on a reactor are given. (auth)

52344 (CISE-R-168) CONTROL STUDIES ON CIRENE REACTOR. Alessandrini, A.; Berruti, A.; Magni, A.; Massimello, G.; Peterlongo, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Apr 1967. 105p. (In Italian). INIS.

Declassified 1971.

A general picture of control studies under way at CISE on CIRENE-type nuclear reactors is given. Steady-state system characteristics, in particular as regards the main reactivity changes, are first discussed; possible operation programs are presented. The intrinsic dynamic behavior of the reactor coupled to the heat transport system and to the turbogenerator is recalled; a very preliminary study on the boiling moderator as a possible mean to improve stability is presented. The control system is then discussed; two general schemes proved satisfactory: one of the "reactor power control" type, and the other of the "coordinated" type. Safety general schemes are introduced together with a short note on tasks and main characteristics of the data-handling digital computer. (INIS)

52345 (CISE-R-201) PRELIMINARY STUDY OF THE NEUTRON FLUX CONTROL AND SCRAM SYSTEM FOR CIRENE REACTORS. Peterlongo, G.; Possa, G. (Centro Informazioni Studi Esperienze, Milan (Italy)); Valli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct 1966. 59p. (In Italian). INIS.

Declassified 1971.

The studies performed for the selection and the preliminary design of the neutron flux control and scram systems for the CIRENE reactor are summarized. The control system selected has a flowing fluid absorber: a two-phase mixture of gas and poisoned light water, the average density of which is continuously controlled in the core. The scram system injects poisoned light water in a set of vertical tubes in the core; gravity is the principal source of energy. (INIS)

52346 (HEDL-TME-72-91) DEVELOPMENT OF AN UNDER-SODIUM ULTRASONIC SCANNER FOR IN-REACTOR SURVEILLANCE. Ord, R. N.; Smith, R. W. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 49p. Dep. NTIS.

A prototype system devised for reconstructing three-dimensional images of objects or components in liquid sodium cooled nuclear reactors is described. Because liquid sodium is opaque to visible light, ultrasonic scanning is used to reconstruct a pseudo three-dimensional image that can be used to observe the reactor core region for such purposes as: to identify duct assemblies; evaluating conditions of assemblies; to provide calibration backup for handling machinery accuracy and position, etc. (auth)

52347 (JEN-234) THEORY AND CONTROL CALCULATIONS. APPLICATION TO BWR AND PWR. Velarde, G.; Guerra, J. (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica Teorica). 1972. 65p. (In Spanish). Dep. NTIS (U. S. Sales Only).

A theoretical method to extend the applicability of P_1 approximations to strong absorbers is given. Tables of effective diffusion parameters for slab and cylindrical geometry as well as a summary of expressions for obtaining the extrapolation length in cases of interest are included. 21 references. (auth)

52348 (RD/B/N-2148) GREY CONTROL ROD REACTIVITY AND POWER DISTRIBUTION MEASUREMENTS IN A CAGR TYPE LATTICE. Ballard, P. J.; Bridge, M. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1972. 42p. (RPC/RPNK/P-(72)7). Dep. NTIS (U. S. Sales Only).

In order to examine the accuracy of rod worth calculations, reactivity and power distribution measurements for interstitial and in-channel grey rods were made on a large pitch CAGR type assembly at ambient temperature, and the results were compared with theoretical data. Sensitivities of predicted rod worths to lattice data and the method of handling reactor codes were established. It is shown that variations in predicted rod worths of order 25% are possible from different combinations of data and handling methods. (24 references) (U.K.)

52349 (RDT-C-17-4-T(2-72)) GENERAL INSTRUMENTATION. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1972. 47p. RSO.

The general requirements are presented for design, manufacture and testing of instrumentation equipment and related services. This instrumentation, referred to as "equipment" comprises complete readout equipment, wiring internal and external to cabinets, and racks and power supplies necessary to furnish the required electrical power for equipment from a standard power source. (auth)

52350 (RDT-E-6-36-T(7-72)) LOW LEVEL FLUX MONITOR MECHANICAL SYSTEM FOR LIQUID METAL SERVICE (FABRICATION ONLY). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1972. 17p.

The requirements for the fabrication, quality assurance, packaging, cleaning, and delivery of the mechanical system for a Low Level Flux Monitor (LLFM) for Liquid Metal Service, are presented. The LLFM mechanical system provides access for the instrumentation required to measure the reactivity of the reactor during startup, maintenance and refueling operations. It also provides access to the core mid-plane in the proximity of the core centerline. The final location of the LLFM will depend on obtaining an adequate signal to noise ratio. The LLFM assembly consists of a neutron sensor and its associated support hardware housed and shielded from the reactor coolant by a composite thimble. It is designed to provide an adequate thermal environment for the neutron sensor and to minimize the radiation streaming to the ex-vessel environment. (auth)

52351 DATA SHEETS ON REACTOR CONTROL. Brennst.-Waerme-Kraft; 24: No. 7, 273-5(Jul 1972). (In German).

Data sheets on KNK Reactor Control are presented. (J.M.J.)

52352 FAST INITIAL RESPONSE NUCLEAR REACTOR CONTROL SYSTEM. Hogle, John J. (to General Electric Co.). U. S. Patent 3,671,390. 20 Jun 1972. Filed 14 Feb 1969.

A control system for boiling moderator—coolant reactors giving fast response to load changes is disclosed. In this system, the broad operating level of the reactor is set by adjusting the control rods. Then, the reactor operating level is adjusted to follow load requirements by changing the coolant recirculation flow rate. In order to provide fast initial response to rapid load changes, an arrangement is provided cooperating with the recirculation flow control to lower the pressure-regulator set point when steam demand increases so that reactor internal pressure is temporarily decreased, causing increased steam generation due to flashing and sending more steam to the load. A cooperating bypass system is provided to accommodate large sudden decreases in the load steam requirements. (Official Gazette)

52353 FLOW REGULATOR. Shaw, James William Westgarth (to United Kingdom Atomic Energy Authority). British Patent 1,275,413. 24 May 1972. Filed 12 Aug 1968.

Reference is made to regulators for regulating the flow of coolant through the fuel element channels of nuclear reactors. In the conventional use of gag valves, these are normally adjacent to the charge face and are removed with the fuel during fuel change. This results in an enhanced coolant flow through fuel channels not only due to the absence of fuel but also the absence of the gag valves. This in turn renders replacement of fuel elements difficult and greatly increases the risk of fuel element damage, particularly if the elements are linked together to form stringers. The flow regulator described comprises a fixed member and a movable valve member, and is provided with two inlet ports and an outlet port so arranged that the movable member is displaceable as a result of flow or pressure in the second inlet port without substantially affecting the flow impedance between the second inlet port and the outlet port, but regulating the flow from the first inlet port to the outlet port. The movable member may be adapted to transmit the load imposed on it by a fuel element stringer to the fixed member, with the movable member displaceable as a result of flow or pressure in the second inlet port in the absence of the load. (UK)

Containment Systems, Waste Processing, and Radiation Protection

52354 (CISE-R-213) PRELIMINARY STUDY OF THE SHIELDING OF A CIRENE TYPE REACTOR. Alberto, G.; Servo, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Informazioni Studi Esperienze, Milan (Italy)). Jul 1967. 45p. (In Italian). INIS.

Declassified 1971.

A study on the dimensioning of the neutron, thermal and biological shields for a CIRENE type reactor and on the control of some radiation streaming is described. For the calculations the MAC-RAD code set up on the basis of the MAC code was used. (INIS)

52355 (COO-3019-1) SEMIANNUAL PROGRESS REPORT, SEPTEMBER 1, 1971-FEBRUARY 29, 1972. First, M. W.; Underhill, D. W.; Hall, R. R.; Baldwin, T. W.; Moeller, D. W. (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Apr 1972. 42p. Dep. NTIS.

The sodium aerosol program was concerned with measuring sodium deposition rates in heat exchangers and centrifugal blowers unprotected by prefilters. Deposition occurs at predictable rates. Methods of cleaning heat exchanger tubes while in service with brief blasts of compressed nitrogen were explored and found to be practical. A fission gas adsorption bed operated under pressure will lose a portion of the adsorbed gases in the event of an accidental rupture of the container and release of pressure. Theoretical and laboratory studies show that the fractional release of fission gases will be smaller than the ratio of the initial to the final bed pressure and that the fraction of krypton released will be greater than the fraction of xenon released under the same conditions. (auth)

52356 (EURFNR-978) THEORETICAL TREATMENT OF AEROSOL BEHAVIOR IN CLOSED CYLINDRICAL CONTAINERS (PARDISEKO 1). Keller, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-1490. 23p. Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

After a heavy accident in a reactor it is possible that nuclear aerosols reach the reactor containment. The behavior of these aerosols is governed by the following processes: sedimentation, diffusion, and coagulation. These physical processes are treated mathematically and a digital computer program was developed (PARDISEKO 1). In the numerical calculation it was assumed that the initial concentration in the cylindrical containment is constant. The particle concentration as a function of time was calculated and compared with results found by experimental measurements. (7 references) (auth)

52357 (N-72-17734) OPTIMIZED $4\text{-}\pi$ SPHERICAL SHELL DEPLETED URANIUM—WATER SHIELD WEIGHTS FOR 200 TO 550-MEGAWATT REACTORS. Wohl, Millard L.; Celnik, Jack; Schamberger, Robert D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb 1972. 13p. (NASA-TM-X-2503; E-6664). NTIS.

Optimization calculations to determine minimum 4π spherical-shell weights were performed at 200-, 375-, and 550-megawatt-thermal reactor power levels. Monte Carlo analyses were performed for a reactor power level corresponding to 375 megawatts. Power densities for the spherical reactor model used varied from 64.2 to 256 watts per cubic centimeter. The dose rate constraint in the optimization calculations was 0.25 mRem per hour at 9.14 meters from the reactor center. The resulting shield weights were correlated with the reactor power levels and power densities by a regression analysis. The optimum shield weight for a 375-megawatt, 160-watt-per-cubic-centimeter reactor was 202,000 kilograms. (auth) (STAR)

52358 (ORNL-TM-3881) FAST REACTOR SHIELDING MONTHLY PROGRESS REPORT FOR MAY 1972, 189a NO. 10028, ACTIVITY NO. 40 01 61. Mynatt, F. R.; Gritzner, M. L.; Maerker, R. E.; McGregor, B. J. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 24p. Dep. NTIS.

- FAST TEST REACTOR—fuel elements for, computer program calculation of power in stored
  - —neutron flux in cavity and vessel support system of, (T)
  - —gamma radiation distributions in vessel support system of, (T)
- GAMMA RADIATION—distribution in test reactor vessel support system, (T)
- NEUTRONS—flux distribution in test reactor cavity and vessel support system, (T)
- REACTOR FUEL ELEMENTS—power in stored, effects of configuration on calculation of
- TOWER SHIELDING FACILITY—pipe chase mockup in, neutron streaming in, (E/T) (D.C.C.)

52359 ICE CONDENSER CONTAINMENT SYSTEM. Thaele, R. (Technical Univ., Dresden). Kernenergie; 15: No. 1, 5-9 (Jan 1972). (In German).

Ice condenser containment system is an efficient safety containment for high-power pressurized-water reactors. The principle of action of this system for a loss of coolant accident, the technological and structural layout, and some special problems of the ice condenser are discussed. Low design parameters for the containment seem to be possible also in the case of compact arrangement of the coolant loop and, consequently, essential advantages can be expected for structural layout. Ice condenser containment has a low amount of leakage in the case of loss of coolant accident and, therefore, is appropriate for town sites of nuclear power plants. Before long, this system will be used in five large reactor blocks. (auth)

52360 PRESSURE VESSEL FOR NUCLEAR REACTORS. Stoll, A. (to Kraftwerk Union AG). German Patent 2,032,791. 13 Jan 1972. (In German).

A description is given of the design of a pressure vessel to be subjected to high pressures and high temperatures with a cylindrical or polygonal outer liner. The inside room consists of prismatic tubes running in parallel, or almost in parallel, with the outer liner, being braced with each other, so that a comparatively thin-walled outer liner can be used, as compared with an unbraced vessel, which in turn leads to a reduction of the temperature-induced strains in the wall. (GF)

52361 PRESSURE VESSEL FOR NUCLEAR REACTORS. Kuenstle, K. (to Kraftwerk Union AG). German Patent 2,033,179. 13 Jan 1972. (In German).

A description is given of the design of pressure vessels which will be subject to high pressure and high temperatures, with the outer liner having a cylindrical or polygonal shape. The inner space consists of prismatic tubes running parallel or nearly parallel to the outer liner, and which are braced with each other. (GF)

Coolant System

Refer also to abstracts 50733, 51040, and 52614.

52362 (ANL-7835) REMOVAL AND REPAIR OF EBR-II PRIMARY SODIUM PUMP NO. 1. Cerutti, B. C.; Deegan, G. E.; Nulton, J. D.; Perry, W. H.; Seever, R. E. (Argonne National Lab., Ill.). May 1972. Contract W-31-109-eng-38. 55p. Dep. NTIS.

Sodium pump No. 1 in the primary system of Experimental Breeder Reactor II (EBR-II) was removed because of periodic increases in its power consumption with no corresponding changes in primary sodium flow. Before removal, the pump had been operated satisfactorily for over 32,000 hr during an eight-year period. Disassembly of the pump revealed heavy oxide deposits on the pump shaft at and above the lower labyrinth. The labyrinth itself was badly corroded and required replacement. The entire pump assembly was disassembled, cleaned, inspected, and reassembled before reinstallation in the primary tank. Some minor alterations were made to the pump assembly to improve its performance. The most significant alteration was the relocation of the sodium drain holes in the baffle subassembly. This change will direct the argon purge in a manner expected to reduce sodium oxide deposits on the pump shaft. Pump operation subsequent to repair and reinstallation has been normal. Shaft torques and power consumption have returned to the levels experienced before pump difficulties developed. (5 references) (auth)

52363 (ANL/EBR-53) CONTROL OF SECONDARY-SODIUM FLOW IN EBR-II. Moon, R. D.; Moriarty, K. J. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Feb 1972. Contract W-31-109-eng-38. 56p. Dep. NTIS.

Control of secondary-sodium flow in EBR-II has been the most difficult and time-consuming operation performed by an operator. A very small change in flow directly affects the temperature of the primary coolant, which must be held within very close limits. Flow control was affected by changes in ambient temperature and perturbations on the power system and was complicated by the time lag between the primary- and secondary-sodium systems. The addition of a limited automatic flow-control system minimized the operator-performed functions by essentially eliminating the adverse effects of changes in ambient temperature and perturbations on the power system. The remaining operator function is to match the secondary-sodium flow to the temperature of the primary coolant and to switch to automatic control for continuance of the match. The flow-control system is composed of commercially manufactured components carefully matched and interconnected to satisfy a complicated and complex control requirement. (auth)

52364 (DP-Report-547) EXAMINATION OF A DRAGON REACTOR PRIMARY HEAT EXCHANGER AFTER CORROSION FAILURE. Project DRAGON. Gray, P. S.; Hamilton, J. D.; Smith, D. L. G. (Atomic Energy Establishment, Winfrith (England)). May 1968. 124p. Dep. NTIS (U. S. Sales Only).

The nature and extent of the water side on load corrosion in a Dragon heat exchanger is described in detail. Some possible causes of the damage are considered and an assessment made of methods by which further corrosion in future heat exchangers could be avoided. 9 references. (auth)

52365 (EURFNR-983) FORTRAN PROGRAM FOR CALCULATION OF STEAM GENERATORS. Spilker, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-715. 100p. Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

A computer program is described for the thermal calculation of steam generators and reheaters for various primary fluids. The program was established within the work on the Fast Breeder Project and is used to determine the characteristic thermodynamic and geometric design data of heat transfer components of the cooling circuits which are required for preliminary investigations and the preparation of studies. The program was made flexible enough to be applicable in principle to all steam generating systems relevant to reactor plants. To ensure rapid evaluation of results, the computed data may be represented as diagrams simultaneous with computation, in addition to the usual output. The basic structure of the computer program is explained by a simplified block diagram. A detailed description of the applicability of the program, input and output, and a comprehensive explanation of possible false indications are presented. The lists of all computer programs are contained which are necessary to carry out the main program. (auth)

52366 (INIS-mf-234) LMFBR MAIN HEAT EXCHANGER DESIGN CRITERIA. Pavese, M.; Ferrari, G. (Ansaldo S.p.A., Genoa (Italy)). 1971. 29p. (In Italian). INIS.

Recent studies performed on the main Na–H_2O heat exchanger are described and the most promising design is illustrated and conceptually justified. (INIS)

52367 (KFK-1587) THERMAL SIMULATION OF FUEL RODS WITH INDIRECTLY ELECTRICALLY HEATED RODS. Malang, S.; Rust, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). May 1972. 45p. (In German). Dep. NTIS (U. S. Sales Only).

The example of a rod eccentrically arranged in an annulus with sodium flow was used to investigate the accuracy with which it is possible to simulate the conditions existing in an oxide-fuel rod using indirectly electrically heated rods of different geometry. The temperature field in the rod and in the cooling channel was calculated. A comparison was made under the assumption of a fully developed temperature profile at slug slow and pure thermal conduction in the coolant. Several theoretical assumptions often made of a constant heat flux or a constant temperature at the inner or outer surface of the cladding were included in the investigation. The influences of the material and the thickness of the electrical insulation as well as of the cladding on the quality of the simulation was studied. Furthermore, the effects of fabrication tolerances were considered. The experimental results are compared with theoretical results achieved with an analytical method using a defined similarity theorem. (auth)

52368 (KFK-EXT-8/72-1) EXPERIMENTAL INVESTIGATION OF THE BOILING OF SODIUM IN NARROW CHANNELS AND ITS USE IN FAST REACTORS. Peppler, F. W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Feb 1972. 130p. (In German). Dep. NTIS (U. S. Sales Only).

The phenomena occurring in sodium boiling in narrow channels up to the onset of dryout were investigated experimentally under conditions which are typical of the sub-channels of fuel pin bundles. The test rig is described and the reliability of the results achieved is discussed. It is proved that the test results can be extended to complete fuel pin bundles. The studies are limited to integral disturbances. The boiling process, influenced by various initial situations, is broken down into individual events and explained in terms of physics. Existing models, such as BLOW 2, are discussed and checked against the measured sequence of boiling events. Methods of estimating individual boiling events are indicated which allow a reliable prediction of these occurrences. 75 references. (auth)

52369 (RDT-E-5-2-T(5-72)) ELECTRIC HEATER AND CONNECTOR ASSEMBLY FOR PRESSURIZER FOR PRESSURIZED WATER REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1972. 26p. RSO.

The requirements are specified for design, fabrication, testing and inspection of a single electric heater and connector assembly for pressurizers for pressurized water nuclear reactors. (auth)

52370 (RDT-M-14-1-T(7-72)) SODIUM COVER GAS: PURCHASE SPECIFICATIONS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1972. 7p.

Purity requirements are presented for the procurement of inert gases (argon, helium, and nitrogen) used to cover sodium in liquid metal fast breeder reactors and supporting test systems. The allowable impurities in the gases are given. In addition, procedures for sampling and analysis and for shipment of the gases are delineated. (auth)

52371 (WCAP-7924) BASIS FOR HEATUP AND COOLDOWN LIMIT CURVES. Hazelton, W. S.; Anderson, S. L.; Yanichko, S. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). Jul 1972. 45p. Dep. NTIS.

The fracture toughness requirements for ferritic components of nuclear reactor systems are presented. The allowable pressure and temperature relationships for normal plant heatup and cooldown rates are described. The methods used to conservatively estimate the material properties for the fracture toughness requirements are discussed. 2 references. (D.C.C.)

52372 MOLECULAR SIEVE PLANT AS THE MAIN HELIUM PURIFIER FOR A HIGH TEMPERATURE, GAS COOLED REACTOR. Harper, C. (United Kingdom Atomic Energy Authority Reactor Group, Winfrith, Eng.). Chem. Eng. (London); No. 263, 271-6(Jul 1972).

The current position on the basic design of a coarse helium purification plant for a high-temperature gas-cooled reactor is presented. It is proposed that a carbon dioxide molecular sieve adsorption bed operating at sub-zero temperature should be adopted and the advantages of such a system are described. It is also shown that further experimental work is necessary on molecular sieves operating at sub-zero temperature if the most economical and reliable plant is to be obtained. (auth)

52373 INTEGRATED COOLANT CIRCUIT NUCLEAR REACTORS. Costes, Didier; Delisle, Jean-Paul; Gallo, Sabino; Schaller, Karl (to Commissariat a l'Energie Atomique). French Patent 2,077,444. 29 Oct 1971. Filed 4 Apr 1969. (In French).

An integrated coolant circuit for nuclear reactors in which the fuel core is cooled by the circulation of a liquid (principally fast neutron liquid Na-cooled reactors) is described. A solution is given for the problems connected with the large temperature differences existing between the liquid at the core output and the exchanger output, in the usual case where the liquid crosses the core in an ascending sense and the heat exchangers are situated laterally in relation to the core of the principal vessel. The method consists of sending the cold liquid from the exchanger outlet into the upper part of the principal vessel, the circulation of this liquid (along at least part of its path) near to the wall of the principal vessel being ensured. (France)

52374 IMPROVEMENTS IN OR RELATING TO GAS COOLED NUCLEAR REACTORS. Simpkin, Sidney David; Crawley, Ralph Hugh Alfred (to British Nuclear Design and Construction Ltd.). British Patent 1,275,043. 24 May 1972. Filed 9 Apr 1968.

Reference is made to reactors using graphite-clad fuel. Should water leak through faulty heat exchanger tubes into the coolant gas, it will react with the graphite to form CO and H_2, thereby reducing the useful life of the fuel. Disadvantages of using conventional dryers are stated. In the system described, carbonaceous material is provided in the coolant gas circuit, the nature and location of this material being such that moisture carried by the coolant gas reacts therewith, the rate of reaction between the moisture and the material being greater than the rate with the graphite cladding. The carbonaceous material may be activated graphite and may incorporate a catalyst. (UK)

Fuels and Fuel Elements

Refer also to abstract 51110.

52375 (AEG-E3-1883(Pt.2)) SODIUM-COOLED HIGH-ENERGY LEVEL BREEDER REACTOR. REFERENCE STUDY. Amon, F.; Lill, G.; Tischer, G.; Uhde, W. (comps.) (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Grosswelzheim (West Germany)). Apr 1971. vp. (In German). INIS.

Development work carried out by AEG-Telefunken over the years 1969 and 1970 is described. The major items of Vol. 2 are: fuel rod concepts, oxide and carbide fuels, comparison of the appropriate reference designs, design of fuel elements with nitride fuels, example of the design of a 3000-MW(e)-power plant, explanation of calculation methods, comparative parameter studies. (INIS)

52376 (ANL/EBR-47) CHARACTERIZATION OF THE POWER IN AN EXPERIMENTAL IRRADIATION SUBASSEMBLY OF MIXED-OXIDE FUEL IN EBR-II. Miller, L. B.; Golden, G. H.; Jarka, R. E.; Phillips, K. E. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Sep 1971. Contract W-31-109-eng-38. 39p. Dep. NTIS.

Detailed transport analyses were carried out to determine the neutron and γ flux and the isotopic fission rates in EBR-II for run 48E, in which the experimental irradiation subassembly, X108, was irradiated. These results were used to compute the axial power distribution in each of the 19 experimental fuel pins in subassembly X108. Local and global variations in the neutron and gamma flux as well as transient effects were taken into consideration in the calculations. (auth)

52377 (CISE-R-267) TEST ELEMENT FOR CRITICAL HEAT FLUX, PRESSURE DROP, AND DENSITY MEASUREMENTS: 19 CLUSTERED RODS, MAXIMUM DESIGN POWER 5.5 MW. Adorni, N.; Azzoni, A.; Germani, G.; Lumachi, A.; Marelli, A.; Misani, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jul 1968. 21p. INIS.

Declassified 1971.

Design and construction of a test element for heat transfer experiments carried out in the framework of the CIRENE-3 program are dealt with. The element main characteristics are: bundle of nineteen 20 mm diameter demountable rods; heated length 3 m; maximum design power 5.5 MW (50,000 A – 110 V); maximum operating pressure 70 kg/cm^2 abs.; pressure tube consisting of 19 electrically insulated tube segments to allow use of metallic spacers on the rod bundle and to strongly reduce the probability of short circuits in case of rod bending; and more than 150 measurements points of rod temperature. The demountable rods and the pressure tube in segments makes it easy to substitute both rods and spacers and to vary the test element length. (INIS)

52378 (DP-Report-555) PRESSURE DROP MEASUREMENTS ON DRAGON FUEL ELEMENT SPIKES. Project DRAGON. Hollick, R. C.; Woodley, H. J. (Atomic Energy Establishment, Winfrith (England)). May 1968. 17p. Dep. NTIS (U. S. Sales Only).

Pressure drop measurements were carried out on Dragon fuel element spikes under standard flow conditions using helium and air as the pressurizing media. Under standard mass flow conditions of 12.5 g/min, using helium at a pressure of 20 atm and at a temperature of 350°C, the overall pressure drop was 0.55 psi. With air at NTP the overall pressure drop was 0.48 psi. (auth)

52379 (DP-Report-565) FIPDIG: A ONE-DIMENSIONAL TIME DEPENDENT FISSION PRODUCT DIFFUSION CODE. Project DRAGON. Preinreich, G. (Atomic Energy Establishment, Winfrith (England)). Aug 1968. 22p. Dep. NTIS (U. S. Sales Only).

The one-dimensional, time dependent fission product diffusion code FIPDIG is described. The code can calculate concentration profiles of decaying fission products in slab, cylinder or spherical geometry for any number and arrangement of fuel zones and fuel free zones, allowing for boundary conditions with continuous concentrations as well as discontinuous concentrations (evaporation boundaries). The diffusion coefficient is constant in any given zone. The code also calculates steady state diffusion profiles. For both time dependent and steady state solutions, the fractional release, the R/B value, and the releases in μCi are calculated. (auth)

52380 (EURFNR–955) FAST BREEDER PROJECT. Second Quarterly Report, 1971. Hueper, R. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). Translation of report KFK–1271/2. 176p. Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

REACTOR FUEL ELEMENTS—fabrication of uranium oxide (UO_2) rods, for fast breeder reactors
—radiation testing of uranium oxide (UO_2) rods, for fast breeder reactors
—cladding for fast breeder reactor, creep characteristics of
—burnup for fast breeder, calculations for
—thermal hydraulic characteristics of liquid sodium cooled assemblies, for fast breeder reactors, (E)
REACTORS, BREEDER—fuel elements for fast, fabrication and radiation testing of uranium oxide (UO_2) rods
—fuel element cladding for fast, creep characteristics of
—fuel elements for fast, burnup calculations for
—physics measurements for fast
—safety aspects of fast
—radioactive effluents from fast
—fuel element assemblies for liquid sodium cooled fast, thermal hydraulic characteristics of, (E)
REACTORS, FAST—fuel elements for breeder, fabrication and radiation testing of uranium oxide (UO_2) rods
—fuel element cladding for breeder, creep characteristics of
—coolant for breeder, corrosive effects of liquid sodium
—fuel elements for breeder, burnup calculations for
—physics measurements for breeder
—safety aspects of breeder
—radioactive effluents from breeder
—fuel element assemblies for liquid sodium cooled breeder, thermal hydraulic characteristics of, (E)
REACTORS, LIQUID METAL-COOLED—fuel element assemblies for fast breeder, thermal hydraulic characteristics of, (E)
SODIUM—corrosive effects on stainless steel of liquid
STAINLESS STEEL—corrosion by liquid sodium (D.L.C.)

52381 (EURFNR–984) FAST BREEDER PROJECT. Third Quarterly Report, 1971. (Kernforschungszentrum, Karlsruhe (West Germany)). Translation of KFK–1271/3. 235p. Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

NEUTRONS, FAST—effects on mechanical properties of fast breeder reactor fuel element cladding
REACTOR FUEL ELEMENTS—radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2), plutonium carbide (PuC)–uranium carbide (UC), and plutonium nitride (PuN)–uranium nitride (UN)
—fabrication of plutonium carbide (PuC)–uranium carbide (UC) and plutonium nitride (PuN)–uranium nitride (UN) rods, for fast breeder reactors
—cladding for fast breeder reactor, fast neutron radiation effects on mechanical properties of
—thermal hydraulic characteristics of liquid sodium cooled assemblies, for fast breeder reactors, (E)
REACTORS, BREEDER—fuel elements for fast, radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2) rods
—fuel elements for fast, fabrication and radiation testing of plutonium carbide (PuC)–uranium carbide (UC) and plutonium nitride (PuN)–uranium nitride (UN) rods
—fuel element cladding for fast, fast neutron radiation effects on mechanical properties of
—coolant for fast, corrosive effects of liquid sodium
—physics measurements for fast
—safety aspects of fast
—instrumentation for fast, development of
—radioactive effluents from fast
—fuel element assemblies for liquid sodium cooled fast, thermal hydraulic characteristics of, (E)
REACTORS, FAST—fuel elements for breeder, radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2) rods
—fuel elements for breeder, fabrication and radiation testing of plutonium carbide (PuC)–uranium carbide (UC) and plutonium nitride (PuN)—uranium nitride (UN) rods
—fuel element cladding for breeder, fast neutron radiation effects on mechanical properties of
—coolant for breeder, corrosive effects of liquid sodium
—physics measurements for breeder
—safety aspects of breeder
—instrumentation for breeder, development of
—radioactive effluents from breeder
—fuel element assemblies for liquid sodium cooled breeder, thermal hydraulic characteristics of, (E)
REACTORS, LIQUID METAL-COOLED—fuel element assemblies for fast breeder, thermal hydraulic characteristics of, (E)
SODIUM—corrosive effects on steel of liquid
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR—physics measurements for
STEEL—corrosion by liquid sodium (D.L.C.)

52382 (KFK–1376) CONSTRUCTION, IRRADIATION, AND FOLLOW UP OF THE OXIDE FUEL ROD TEST IN FR 2. Freund, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). May 1972. 82p. (In German). Dep. NTIS (U. S. Sales Only).

The irradiation of fuel pin samples with oxide fuel and stainless steel cladding in the Karlsruhe thermal reactor FR 2 represents the first phase of an extensive irradiation program dealing with the development of fuel elements for fast breeder reactors. Two hundred ninety two samples were irradiated in irradiation rigs in core positions as well as in the short-term irradiation facility in the FR 2 helium loop. This phase of the program includes irradiation of samples with UO_2 fuel, partially with different admixtures (Mo, CeO_2), and with UO_2–PuO_2 fuel of various enrichments and densities. The cladding materials of these samples consist of the austenitic stainless steels 1.4541, 1.4550, 1.4970, 1.4981, and 1.4988. The fuel pin outer diameters vary in the range of 4.7 to 12.0 mm, with fuel lengths between 80 and 225 mm. The irradiation time of the samples covers the range of from some minutes up to 600 days (full power equivalent). The linear rod power lies between 300 and 1000 W/cm at clad temperatures from 340 to 800°C. Maximum burnup values of about 120 MWd/kg metal were achieved. Specifications and production of the samples, irradiation data, and some results of post-irradiation examination are reported and discussed. (auth)

52383 (KFK–1377) CONSTRUCTION, IRRADIATION, AND DESTRUCTION FREE FOLLOW UP OF THE UO_2–PuO_2 FUEL ROD BUNDLES DFR-350. Geithoff, D.; Kummerer, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). May 1972. 190p. (In German). Dep. NTIS (U. S. Sales Only).

Within the fuel pin development for fast breeder reactors the irradiation experiment DFR-350 comprises irradiation of a 77-pin-bundle containing UO_2–PuO_2 fuel and stainless steel cladding. The experiment was performed in the fast flux of the Dounreay Fast Reactor with NaK-cooling. The design of the fuel pins with respect to composition and geometry as well as to operational conditions was highly representative of a prototype fast reactor such as the SNR-300. The fuel smear density was 80% of the theoretical value and the PuO_2 content was 20 wt %. The stainless steel cladding had a wall thickness of 0.38 mm, the pin outside diameter was exactly 6.0 mm. As far as the length of the pins is concerned, it was not possible to simulate real fast breeder conditions with the exception of the ratio between fuel volume and fission gas plenum. The pin included a fuel length of 29 cm and an axial blanket region of UO_2 in conjunction with the gas plenum. Operational conditions during irradiation are characterized by a maximum linear rod power of 450 watts/cm and a maximum cladding temperature of 630°C. The target burnup was 50,000 megawatt days per metric ton of heavy metal atoms. The bundle was equipped with nearly identical pins of different origin. CEA, France, provided 38 pins, while 16 pins were provided by the Belgian partners of the Debenelux-Breeder-Project, and 23 pins were provided by the German side. All 77 pins reached the target burnup without any functional disturbances or externally visible damage. This irradiation experiment is documented and the pins of the German contribution are chiefly considered. The first sections of the report deal with the design and specifications of the pins including detailed design calculations and safety considerations. Actual irradiation in the DFR, post-irradiation examination of the whole bundle, and nondestructive examination of the 23 German pins are described. The most important conclusions are that all the pins reached the scheduled target burnup and the pins with cladding of 1.4988 stainless steel show a markedly smaller diameter increase than those pins with 1.4961 cladding. (auth)

52384 (KFK-1555) THEORETICAL INVESTIGATION OF THE WALL TEMPERATURE MEASUREMENT IN SIMULATED FUEL RODS FOR THERMODYNAMIC EXPERIMENTS IN SODIUM. Moeller, R.; Tschoeke, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Apr 1972. 45p. (In German). Dep. NTIS (U. S. Sales Only).

The installation of thermocouples into the cladding tube of heating rods, which are heated in an indirect and stationary way, results in a disturbance of the temperature field and heat flow. Temperature fields within the zone of disturbance were calculated for various combinations of materials and corrections to the measured values were determined for the signal indicated by the thermocouple. These corrections yield the surface temperature in the undisturbed zone. Moreover, the variations of corrections to measured values were determined which are caused by uncertainties of the installation geometry as well as of the thermal conductivity of solders. It was found that thermocouples with BN-insulation together with nickel solder in a steel sheath will cause only a small disturbance of the heat flow and, hence, provide good conditions for the determination of local surface temperatures. In this case, an accuracy of the calculated correction to the measured value of about ±25% is obtained. 8 references. (auth)

52385 (ORNL-4801, pp 25-49) MOLTEN SALT REACTOR STUDIES. (Oak Ridge National Lab., Tenn.). Jul 1972.

In Reactor Chemistry Division annual progress report, 1972.

ALKALINE EARTHS METALS— separation from MSBR fuel, precipitation and ion exchange studies of, p. 42-4
BISMUTH TELLURIDES— thermal stability of, p. 34
BORON FLUORIDES— vapor pressure of, development of stirrer assembly for determining melt composition from measurements of, p. 47-8
CHROMIUM TELLURIDES— thermal stability of, p. 34
FISSION PRODUCTS— separation of MSBR, from molten lithium chloride by ion exchange or precipitation, p. 42-4
  — deposition on surfaces of molten salt reactor fuel system, (E) p. 27-30
  — corrosive effects on molten salt reactor fuel system, (E) p. 31-3
FLUOROBORATES— oxide and hydroxide removal from molten MSBR, development of methods for, p. 44-5
FUSED SALTS— melt composition of, development of stirrer assembly for determining, p. 47-8
HELIUM— solubility in molten lithium beryllium fluoride at 600°C, p. 35
HYDROGEN— solubility in molten lithium beryllium fluoride at 600°C, p. 35
  — permeation of metals by, 4×10^{-3} to 30 Torr, p. 36
  — permeation of oxide-covered metals, p. 37
HYDROXIDES— solubility in fluoroborate coolant salt, p. 38-9
  — separation from molten fluoroborate coolant mixture, development of methods for, p. 44-5
MOLTEN SALT BREEDER REACTOR— fuel system for, fission product effects on cracking of metal surfaces in, (E) p. 31-3
MOLTEN SALT REACTOR EXPERIMENT— fuel system for, fission product concentrations on surfaces of, (E) p. 27-30
MOLYBDENUM TELLURIDES— thermal stability of, p. 34
NICKEL TELLURIDES— thermal stability of, p. 34
OXIDES— separation from molten fluoroborate coolant mixture, development of methods for, pp. 44-5

52386 (WCAP-4167-3) EEI: WESTINGHOUSE PLUTONIUM RECYCLE DEMONSTRATION PROGRAM. Letter Progress Report for the Period January-September 1971. Haley, J. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Oct 1971. Contract AT(30-1)-4167. 13p. Dep. NTIS.

Progress in the EEI-Westinghouse Plutonium Recycle Program during the period January through September 1971, is reported. The Demonstration Assemblies continued planned performance in the San Onofre reactor which operated during the entire report period. Peak burnup in the Demonstration Assemblies is 9750 MWD/MTM. Preparations were started for the January 1972 refueling which will include on-site inspections. (auth)

52387 POSSIBILITIES AND CONDITIONS OF SUPPLYING FUEL FOR NUCLEAR POWER PLANTS. Mojovic, L.-j. Elektroprivreda; 23: No. 3-4, 117-25(1970). (In Serbo-Croatian).

A survey of the actual state on the world market and of the tendencies in the coming period of time is made. The possibilities of ensuring individual phases of the combustion cycle from the country's resources were analyzed in consideration of Yugoslavia's estimated needs. A comparison was made between the natural and enriched uranium cycle from the point of view of rational use of the raw materials and autonomy of supply. (auth)

52388 IDENTIFICATION OF FAILED FUEL ELEMENTS. Crouthamel, Carl E.; Coleman, Lester F.; Bernstein, George J.; Henault, Peter B. (to United States Atomic Energy Commission). U. S. Patent 3,663,363. 16 May 1972. Filed 13 Mar 1969.

Each subassembly in a breeder reactor is tagged with a gas containing a different mixture of xenon isotopes having a mass number from 124 to 130. The reactor cover gas is tested for fission-product gases and if any are found they are tested for light xenon isotopes to identify which subassembly has failed. (Official Gazette)

52389 HYDRAULIC HOLD-DOWN FOR NUCLEAR REACTOR FUEL ASSEMBLY. Finch, Lester M.; Anthony, Andy J. (to United States Atomic Energy Commission). U. S. Patent 3,666,624. 30 May 1972. Filed 18 Jul 1969.

An assembly for use in a LMFBR includes a fuel assembly having a nose piece at its lower end and a support receptacle having a socket which receives the nose piece. Openings in the nose piece and socket conduct coolant into the nose piece perpendicular to the longitudinal axis of the fuel assembly. Leakage flow vents extend the length of the nose piece communicating with the interior of the socket below the nose piece and the exterior of the fuel assembly above the top of the receptacle to reduce the lifting effect of the coolant on the fuel assembly. (Official Gazette)

52390 IMPROVEMENTS IN AND RELATING TO A FUEL ASSEMBLY FOR A NUCLEAR REACTOR AND A NUCLEAR REACTOR CORE COMPRISING SUCH FUEL ASSEMBLIES. Marstrand, Jorgen (to Atomenergikommissionen). British Patent 1,274,188. 17 May 1972. Priority date 13 Feb 1970, Denmark.

A fuel assembly for boiling reactors is described which results in an increased energy flux density. The assembly comprises a number of parallel fuel rods arranged in a lattice of regular geometrical figures, with deflectors arranged in the common vertices of adjacent figures of said geometrical figures. Thus, the deflectors (with helical blades) are located in the common inner points of the fuel cluster figures and result in steam-water separation inside the reactor core. For a boiling heavy water reactor, this results in a drop in the heavy water investment. (D.L.C.)

Auxiliary Systems and Engineered Safeguards

52391 (RDT-E-1-36-T(6-72)) FLOOR VALVE, REACTOR REFUELING AND MAINTENANCE FOR LMFBR. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 17p. RSO.

The requirements for the construction of a sealed radiation shielded floor valve for use in a LMFBR refueling system or maintenance system are presented. (H.D.R.)

52392 (RDT-E-9-3-T(6-72)) HIGH-EFFICIENCY PLEATED-BED GAS-PHASE ADSORBER CELLS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 11p. RSO.

The standard covers a single design (pleated bed) of unit-cell adsorber for use in air and gas cleaning applications where very high contaminant removal efficiency is required. Performance, materials, design and construction, and marking requirements are listed and quality assurance requirements are given. (M.C.G.)

52393 (RDT-M-16-1-T(6-72)) GAS-PHASE ADSORBENTS FOR TRAPPING RADIOACTIVE IODINE AND IODINE COMPOUNDS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 16p. RSO.

This standard covers granulated adsorbents for use in nuclear air and gas treatment systems for trapping radioactive iodine. The standard is limited to 8 × 16 mesh adsorbents suitable for use in high-efficiency thin-bed adsorber cells and to adsorbents that have been chemically impregnated to enhance the trapping of radioiodine in the form of organic iodine compounds. Technical requirements, quality assurance requirements, and preparations for delivery are given. (M.C.G.)

52394 SAFETY PLANS FOR NUCLEAR POWER PLANTS. Courvoisier, P. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Strahlenschutz Forsch. Prax.; 11: 11-14(1971). (In German).

From eleventh meeting of the German Medical Radiologists

Protection Association; Zurich, Switzerland (19 Jun 1970). See CONF-700671.

The safety measures and the emergency plans for nuclear power plants are reviewed. (INIS)

Operation and Economics

52395 (DP-Report-594) DRAGON OPERATIONS GROUP TENTH QUARTERLY PROGRESS REPORT, SEPTEMBER–NOVEMBER 1967. Project DRAGON. Chapman, B. G. (Atomic Energy Establishment, Winfrith (England)). Aug 1968. 23p. Dep. NTIS (U. S. Sales Only).

52396 (EUR-4705-E) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1970. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet (France)). 14 Jul 1971. 35p. Dep. NTIS.

The operating conditions and results for the Ardennes Nuclear Power Plant during 1970 and also the essential facts, studies and work relating to these are summarized. Included are: (1) general information; (2) operation statistics; (3) design, studies and construction; and (4) economic data. (auth)

52397 (JAERI-1212) EFFECT OF PLUTONIUM RECYCLED REACTORS ON LONG-TERM FUEL CYCLE IN JAPAN. Yasukawa, Shigeru; Shinohara, Yoshikuni; Shimazaki, Junya (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). 5 Nov 1971. 28p. Dep. NTIS (U. S. Sales Only).

The effect of plutonium recycled reactors on long-term fuel cycle in Japan is analyzed by the FUEL-DEMAND code, which includes two methods of system analysis: one is based on fissile material balance and the other is the optimization by linear-programming technique. Results are presented for calculations for different reactor types. (15 references) (auth)

52398 (JUL-827-HT) TECHNICAL AND ECONOMIC POSITION AS WELL AS PROSPECTS FOR NUCLEAR ENERGY IN THE POWER ECONOMY OF THE FEDERAL REPUBLIC OF GERMANY. PART I. PROGRESS WITH SITUATION, OCTOBER 1971. Bergmann, B.; Kraemer, H. (Kernforschungsanlage, Juelich (West Germany)). Feb 1972. 154p. (In German). Dep. NTIS (U. S. Sales Only).

As seen from the situation in October 1971, the energy requirements and supplies for West Germany are projected up to 1985. Discussed are the electricity requirements of the Federal Republic of Germany, the structure of electricity supply, and the technological trend in modern power plant concepts. Treated are fossil fueled power plants, turbogenerators, and nuclear power plants. Under nuclear power plants, pressurized-water reactors are analyzed especially with respect to neutron-physical and thermohydraulic design, instrumentation, fuel elements, and other features. Under power plant effects on the environment, the following topics are discussed: thermal effluents, radiological effluents, chemical effluents, noise, and esthetics. The various types of fossil fuels are analyzed and compared with nuclear fuels. Fuel cycle, electricity generation, construction and operation of plants are analyzed from an economical standpoint. 181 references. (H.B.G.)

Safety and Siting

Refer also to abstracts 50626 and 51113.

52399 (ANCR-1036) SEMISCALE BLOWDOWN AND EMERGENCY CORE COOLING (ECC) PROJECT TEST REPORT: TESTS 848, 849, AND 850 (ECC INJECTION). Olson, D. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jun 1972. Contract AT(10-1)-1375. 103p. Dep. NTIS.

The results of three decompression experiments (Tests 848, 849, and 850) performed in the Semiscale Blowdown and Emergency Core Cooling (ECC) Project as part of the Water Reactor Safety Program are presented. The data are intended to provide a basis for measuring the maturity of analytical codes used to predict the response of pressurized water reactors to decompression and ECC injection for a hypothetical major loss-of-coolant accident (LOCA). Semiscale Tests 848, 849, and 850 were inlet-break tests of a system that includes an operating loop and a vessel with an electrically heated core. Tests 848 and 849 involved injection of ECC from a pressurized accumulator during decompression. Test 850 was performed from the same initial conditions, but without ECC, to provide a basis for comparison. The objectives of these tests were to obtain more detailed experimental information relative to the effects of ECC on primary system decompression and to determine the mechanism responsible for the expulsion of ECC liquid from the vessel inlet plenum which had occurred in previous semiscale ECC-injection tests. Data from these three tests provide a general explanation of the expulsion mechanism. The test results presented include pressure, fluid and material temperatures, density, flow rates, and fluid quality as functions of time. 9 references. (auth)

52400 (ANL-7947) THERMOHYDRODYNAMIC MODEL FOR MOLTEN UO_2–Na INTERACTION, PERTAINING TO FAST-REACTOR FUEL-FAILURE ACCIDENTS. Cronenberg, August W. (Argonne National Lab., Ill.). Jun 1972. Contract W-31-109-Eng-38. 109p. Dep. NTIS.

As part of the liquid-metal fast-breeder-reactor (LMFBR) safety program, the consequences of molten-fuel release into sodium coolant must be evaluated in order that design constraints might minimize the safety hazard of such an event. The work presented is the first attempt to compare the voiding rates obtained from an in-pile, fuel-failure experiment with theoretical results of a fuel-coolant interaction (FCI) model. The theoretical approach taken was to seek a coupled solution to the energy and momentum equations of a single bubble which expands against an upper and lower liquid slug. During the initial contact period fuel fragmentation is assumed to occur as a result of violent boiling. The resulting active region contains fuel, liquid sodium, and sodium vapor. Within the bubble, finely divided fuel particles interact with sodium, resulting in vaporization and subsequent bubble growth. A thin liquid-film layer is assumed to adhere to the intact portions of the pin and test section, thus allowing for condensation at these surfaces. The model used represents the first analytic treatment of the energy exchange process at all boundaries of the expanding interaction zone. Parametric calculations were made considering the effects of particle size, condensation, and initial fuel-liquid-vapor volume fractions. 94 references. (auth)

52401 (CEA-CONF-1997) DEVELOPMENT AND STUDIES OF RADIOLOGICAL SAFETY OF FRENCH REACTORS AND THEIR SITES. Candes, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 15p. (In French). (CONF-720439-1). Dep. NTIS (U. S. Sales Only).

From International conference on the chemical arts; Paris, France (20 Apr 1972).

52402 (CISE-R-159) ANALOG COMPUTER MODELS FOR THE STUDY OF LOSS-OF-COOLANT AND LOSS-OF-FLOW ACCIDENTS IN STEAM-GENERATING PRESSURE TUBE REACTORS. Biagioli, F.; van Erp, J. B. (Centro Informazioni Studi Esperienze, Milan (Italy)); Gilardi, E. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Sep 1967. 53p. INIS.

Declassified 1971.

Analog models for loss-of-coolant and loss-of-flow accidents in steam-generating pressure-tube reactors are presented, including some of the main analog (electronic) circuits used. These models have the following main characteristics: neutron aspects are treated on the basis of the one-point neutron kinetics; thermal and fluid dynamics aspects are treated on the basis of different core regions, which are distinguished either by their different thermal loads or by different ways in which they are affected by the postulated accidents. Some illustrative results regarding the accidents studied are presented and discussed. (INIS)

52403 (CISE-R-160) SIMPLE ANALOG COMPUTER MODEL FOR THE STUDY OF BLOW-DOWN TRANSIENTS. Leoni, G.; van Erp, J. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1967. 21p. INIS.

Declassified 1971.

A simple analog model for the study of transients regarding the blowdown of high enthalpy coolant is presented. The principal aim of the model is to obtain a first approximation evaluation of the time behavior of the blow-down phenomenon relative to geometries typical of pressure-tube nuclear reactors. The main characteristics of the model are: the cooling circuit is represented by a number of axial segments, to each of which a hydraulic capacity is attributed, having single values for pressure, mass quality, and void fraction; inertial effects are not taken into account; friction pressure drops in two-phase flow are evaluated according to the method indicated by Martinelli-Nelson; and critical two-phase flow is evaluated on the basis of the experimental data of Fauske. (INIS)

52404 (CISE-R-191) ANALOG MODELS FOR THE SAFETY EVALUATION OF STEAM-GENERATING PRESSURE-TUBE REACTORS. Biagioli, F.; Leoni, G.; van Erp, J. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1967. 45p. INIS.

Declassified 1971.

Simplified analog models for the safety evaluation of pressure-tube reactors are described, including the analog circuits used in connection with the models. The main characteristics are: (1) Neutronic aspects are treated by means of the one-point model. (2) Thermal and fluid-dynamics aspects are treated on the basis of a number of representative cooling channels which are chosen either on the basis of their operating conditions (e.g., thermal load), or on the basis of the way by which they are affected by the accident under consideration. Each channel is represented by a single axial segment and by four concentric zones (three for the fuel and one for the cladding). Some illustrative results are presented and commented upon. (INIS)

52405 (CONF-720906–4) INTERACTION OF THE STRUCTURE OF A SELECTED REACTOR CONTAINMENT WITH NEAR KILOBAR NUCLEAR WEAPON SHOCKWAVES IN AIR. Chester, C. V.; Chester, R. O. (Oak Ridge National Lab., Tenn.). Mar 1972. 11p. Dep. NTIS.

From third international symposium on the military preparations of blast simulators; Schwetzingen, West Germany (19 Sep 1972).

The interaction of a selected reactor containment with near kilobar nuclear shockwaves in air was examined both experimentally and via calculations. In the reactor design chosen for investigation, the core is immersed in a cylindrical tank of liquid sodium coolant 15 meters in diameter, 10 meters deep. The tank is covered by a reinforced concrete deck 2 meters thick, with its top at ground level. On top of the deck is a rectangular refueling cell with walls 120 cm thick. Several $\frac{1}{50}$ scale models of the sodium tank, deck, and fuel cell wall were subjected to near-kilobar shocks produced by explosive charges. The incident pressure on the deck and pressure produced in the center of the tank were measured. The measured pressures, and the shapes of recovered models of the steel blast shield under the deck, were used to verify a mathematical model of the blast-structure interaction. Machine computations were used to explore the effects of variations in design parameters of the structure. It is estimated that for the original design an incident weapon shock exceeding 800 bars is required to produce a pressure pulse of 400 bars in the core. (auth)

52406 (HEDL-TME–72-43) MELT-II: A TWO-DIMENSIONAL NEUTRONICS-HEAT TRANSFER PROGRAM FOR FAST REACTOR SAFETY ANALYSIS. Waltar, A. E.; Padilla, A.; Shields, R. J. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 382p. Dep. NTIS.

The MELT-II program is a multichannel neutronics-heat transfer digital computer program developed to investigate the transient behavior of fast reactors for overpower or loss of flow accident conditions. Reactivity feedback due to Doppler broadening, coolant density change and voiding, and fuel movement are taken into account. The core model consists of a maximum of 10 radial channels, 20 axial segments, and 12 radial fuel nodes plus a gap, cladding, and coolant node for each pin. Typical running times, for the UNIVAC 1108, are approximately 4 minutes for an overpower transient and 8 minutes for a loss of flow accident. These times correspond to cases with a substantial amount of printed output plus plotting. Although all programming is in FORTRAN-V, the program is somewhat dependent on system subroutines unique to the UNIVAC 1108 at Richland, Washington. 11 references. (auth)

52407 (IRS-F–9) PROGRESS REPORT ON RESEARCH GOALS IN THE FIELD OF REACTOR SAFETY REQUIRED BY THE MINISTRY OF EDUCATION AND SCIENCE OF THE FEDERAL REPUBLIC OF GERMANY, OCTOBER 1–DECEMBER 31, 1971. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). May 1972. 107p. (In German). Dep. NTIS (U. S. Sales Only).

Research reports covering the last quarter of 1971 are reviewed. Presented are: studies of transients in reactor cores and primary circuits during blowdown and low pressure phase; processes in the containment during accidental loss of cooling medium; core melting; reactivity disturbances; and breakage of the reactor pressure vessel. Two studies concerned environmental protection in the case of extreme accidents. With respect to improvement of operational safety, the following subjects are presented: reactor stability; thermohydraulics; and design, construction, and experimental testing of a reactor container of prestressed concrete. Tests of materials and structural components are presented in three reports. Other subjects treated are: reliability analysis; monitoring of reactor pressure vessels and tubing in the primary system; and development of installations for data reduction as well as process computers with safety functions. (H.B.G.)

52408 (LBL–933) SOME QUANTITATIVE RISK AND BENEFIT COMPARISONS FROM GENERATING ELECTRICITY OF COAL-FIRED AND NUCLEAR-FUELED POWER PLANTS USING DECISION ANALYSIS. Lim, Tek Hian (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1972. Contract W-7405-eng-48. 42p. Dep. NTIS.

Thesis.

Decision analysis was applied to compare some mortality risks and social benefits resulting from generating electricity by coal-fired and nuclear-fueled power plants. A review of the literature indicates that an absolute quantitative comparison in mortality risk and social benefit between these two types of power plants is difficult. The main reason for this is that good statistical data, especially late mortality effects of either low-level long-term radioactivity or exposure to chemical pollutants, are not available. The purpose of the study is to look at the problem from the general public's point of view and to make a comparison between the consequences of the two means of power generation, using data already available. The minimax strategy of expected loss (that is, the most pessimistic strategy) is used. The benefit in quality of life from each consequence is converted into a dollar equivalent, as a measure of the integrated values accruing to each individual. All of the comparative results in the study are in favor of the nuclear-fueled power plants. (29 references) (auth)

52409 (ORNL-TM–3831) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR MARCH–APRIL 1972. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 155p. Dep. NTIS.

The accomplishments during the months of March and April in the research and development program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as blowdown heat transfer studies. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR) and the liquid-metal fast breeder reactor (LMFBR) programs. Other major projects include experimental investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Seismic considerations of particular significance in nuclear plant design are evaluated in the seismic program. Several of the above projects are also directly related to another major undertaking, the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor facilities. The recent activities of NSIC and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the recent emphasis on environmental effects. (auth)

52410 (ORNL-TM–3842) AVAILABILITY OF NUCLEAR STANDARDS INFORMATION. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 18p. (CONF-720442–1). Dep. NTIS.

From Executive conference on nuclear standards; Monterey, CA. (30 Apr 1972).

The number of organizations and technical societies in the nuclear industry producing standards, and the numbers of standards themselves, are such that it is not an easy task to find out what standards are available on a particular subject. This report addresses itself to this problem. (2 figures, 4 tables) (R.W.R.)

52411 RADIATION ACCIDENTS AND THEIR TREATMENT. DIAGNOSIS, PATHOLOGY, THERAPY, AND PROPHYLAXIS. 11th Meeting of the German Medical Radiologists Protection Association, Zurich, June 19–20, 1970. Braun, Heribert; Brunner, Hansheiri; Ladner, Hans-Adolf; (and others) (eds.). Strahlenschutz in Forschung und Praxis, Band XI. Stuttgart; Georg Thieme Verlag (1971). 133p. DM 33,–. (In German and English). (CONF-700671). Intercontinental Medical Book Corporation, New York.

Separate abstracts are included for 11 of the 14 papers presented. Three of the papers have previously been included in NSA. (D.C.C.)

For abstracts of individual papers see: 50565, 50566, 50691, 50863–50869, and 52394.

52412 METHODS OF SAFETY ESTIMATION FOR NUCLEAR POWER PLANTS. Kubis, K.; Uhlmann, G. (Technical Univ., Dresden). Kernenergie; 15: No. 1, 1-4(Jan 1972). (In German).

One of the possibilities of increasing the efficiency of nuclear power plants therefore is optimization of the expenses for safety techniques. The methods of safety estimation used so far, the maximum credible accident model and the probability model, were studied with respect to their appropriateness for solving the problem of optimization. Both concepts turn out to be suitable for designing nuclear power plants with sufficient safety. However, their use does not guarantee the complete economic estimation of safety devices. (auth)

52413 AMERICANS PUSH AHEAD WITH FAST BREEDER REACTORS AFTER 20 YEARS RESEARCH. THE US ATOMIC ENERGY COMMISSION PUTS THE CASE FOR FAST REACTORS IN TERMS OF EFFICIENCY, SAFETY, AND THE ENVIRONMENT. Elec. Rev.; 122-5(28 Jul 1972).

A number of demonstration LMFBR plants of 300 to 500 MW(e) capacity are planned in the U. S. for commissioning before 1980. A summary is presented of an Environmental Statement on Liquid Metal Fast Breeder Reactors published by the USAEC putting forward the argument in favor of these sodium cooled reactors, in terms of efficiency, safety, and the environment. (UK)

Steam and Power Conversion System

52414 CORROSION OF 9 PERCENT CHROMIUM IN AGR BOILERS. Newell, J. E. (Central Electricity Generating Board, London). Nucl. Eng. Int.; 17: No. 195, 637-9(Aug 1972).

Recent experimental work showed that breakaway can occur on 9% Cr 1% Mo steels in Advanced Gas-Cooled Reactor gas conditions at temperatures somewhat above those at which the primary superheater tubes of this material are expected to operate in AGRs which are under construction. The significance of this corrosion was assessed on the assumption that at longer exposure times it will occur at operating temperatures. Its effect will vary between reactors, but the useful operating life might be curtailed unless action is taken to limit the temperatures of critical components. The measures adopted to handle this problem are described and an indication is given of the predicted effect upon life and output. Other remedial measures, including a possible change of coolant to helium, are examined. (auth)

52415 HOW ABOUT A POTASSIUM TOPPING CYCLE. Fraas, A. P. (Oak Ridge National Lab., Tenn.). Elec. Light Power (Boston); 50: No. 5, 45-7(Mar 1972).

Boosting thermal efficiency of fossil-fueled generating plants to 54% by topping a gas turbine—steam combination with a potassium vapor cycle is described. The proposed system is an oil-fired potassium boiler. Air from the compressor of the gas turbine is supplied to the furnace that heats the potassium boiler. The exhaust gas from this furnace then flows to the turbine of the gas turbine unit. The vapor discharged from the potassium turbine would flow directly into a heat exchanger that would serve as the potassium condenser and the steam generator. Component size, weight, and cost are considered. A development program is suggested. (M.C.G.)

52416 METHOD OF UTILIZING THE HEAT PRODUCED BY A REACTOR. Gauthron, Maurice (to Commissariat a l'Energie Atomique). French Patent 2,085,380. 24 Dec 1971. Filed 15 Apr 1970. (In French).

The method involves circulating a coolant in a region of the reactor, where it absorbs the heat produced, and in a vapor generating system, where it ensures the reheating, vaporization, and superheating of a fluid (generally the working fluid of the vapor turbine thermodynamic cycle). A characteristic of the system is the fact that the coolant is redistributed (at least as far as the circulation in the reactor and the vapor generating system is concerned) in two fluxes brought to different temperatures. The first flux (at the lower temperature) undergoes a heat exchange process with the fluid in the liquid state, thus ensuring its vaporization. The second flux (at the higher temperature) undergoes a heat exchange process with the vaporized fluid, thus ensuring the superheating. (France)

52417 METHOD OF UTILIZING THE HEAT PRODUCED BY A REACTOR. Gauthron, Maurice (to Commissariat a l'Energie Atomique). French Patent 2,085,381. 24 Dec 1971. Filed 15 Apr 1970. (In French).

A method of utilizing the heat produced by a nuclear reactor (principally of the heavy water-moderated type) is described. The method involves circulating a coolant, such as CO_2, in a region of the reactor, where it absorbs the heat produced, and a vapor-generating system, where it ensures the reheating, vaporization, and superheating of a fluid. A characteristic of the system is the complementary superheating of the vapor, produced by the vapor-generating system, in another region of the reactor. (France)

52418 IMPROVEMENTS IN OR RELATING TO GAS TURBINE ENGINE POWER PLANTS. Jubb, Albert (to Rolls-Royce Ltd.). British Patent 1,275,753. 24 May 1972. Filed 14 Sep 1968.

Reference is made to gas turbine power plants in which the working fluid is heated directly or indirectly by a nuclear reactor. The system described comprises one or more compressors arranged in parallel, turbines arranged to be driven by the reactor-heated compressed working fluid, and control valves operative to permit part of the compressed working fluid to by pass the reactor and flow to the turbine inlet, in dependence on at least one turbine operating parameter. The turbine system may comprise a high-pressure unit connected to the compressor system, in series with a power turbine, with the control valve responsive to the rotational speed of the high-pressure unit. Where two compressors are employed, together with two control valves systems and two high-pressure turbines, the control system may be adapted to produce a signal that is dependent on the difference between the rotational speeds of the high-pressure turbines, this signal operating to adjust one or other of the control-valve systems so as to reduce this difference. The system may also be adapted to be responsive to the rotational speed of the power turbine and/or the load on this turbine. See also British Patents 1,275,754, 1,275,755, and 1,275,756. (UK)

52419 IMPROVEMENTS IN OR RELATING TO GAS TURBINE ENGINE POWER PLANTS. Jubb, Albert; Ward, Robert George (to Rolls-Royce Ltd.). British Patent 1,275,754. 24 May 1972. Filed 14 Sep 1968.

The power plant described basically comprises a compressor system, means to heat the compressed working fluid, such as a nuclear reactor, and the turbine system. The turbine system is arranged to drive the compressors and to provide a power output suitable for driving an external load. A by-pass duct is provided, connecting with the turbine duct, and having by-pass valve means operative when required to permit part of the heated working fluid to by pass at least part of the turbine system. A further valve means, in series with at least part of the turbine system, is provided to occlude the turbine duct; this valve means is located upstream of the turbine system and downstream of the connection of the turbine and by-pass ducts. Control means responsive to the rotational speed of the turbine system are provided, adapted in one mode of operation to adjust only the by-pass valve system, and in another mode to adjust simultaneously the by-pass valve system and the further valve system in opposite senses. The turbine system may comprise a first turbine connected to the compressor system, and a power turbine arranged downstream of and in series with the first turbine, the by-pass valve system when open permitting part of the heated working fluid, expanded in the first turbine, to by-pass the power turbine. Various modes of operation of the system are described. See also British Patents 1,275,753, 1,275,755, and 1,275,756. (UK)

52420 IMPROVEMENTS IN OR RELATING TO GAS TURBINE ENGINE POWER PLANTS. Jubb, Albert (to Rolls-Royce Ltd.). British Patent 1,275,755. 24 May 1972. Filed 14 Sep 1968.

Reference is made to closed-cycle gas-turbine engine power plants in which the working fluid is heated directly or indirectly by a nuclear reactor. The power plant comprises a compressor system and a turbine system driven by the heated and compressed working fluid, together with heat exchanger and variable-speed pump means for adjusting the temperature of the working fluid entering and/or flowing within the compressor system, so as to adjust the power output of the power plant. The compressor system preferably comprises low- and high-pressure compressors. See also British Patents 1,275,753, 1,275,754, and 1,275,756. (UK)

52421 IMPROVEMENTS IN OR RELATING TO CLOSED-CYCLE GAS TURBINE ENGINE POWER PLANTS. Andrews, Edward George David; Ward, Robert George; Holliday, John Bertram; Hurst, James Norman (to Rolls-Royce Ltd.). British Patent 1,275,756. 24 May 1972. Filed 25 Oct 1969.

The power plant described consists of a compressor system, a nuclear reactor having a pressure vessel and arranged to drive the compressors and to heat the compressed working fluid, and a turbine system. A heat exchanger system cools the working fluid expanded in the turbine and returns the cooled fluid to the compressor system. The compressor and turbine systems are removably located within a cavity in the pressure vessel wall, and the heat exchange system is similarly located in a second cavity. The compressor system may comprise a low-pressure axial flow unit, an intercooler, and a high-pressure axial flow unit, connected in series. See also British Patents 1,275,753 through 1,275,755. (UK)

Commercial Power Reactors

52422 (FIND–50382(8-72)) FIND: WATERFORD STEAM ELECTRIC STATION, UNITS 3 AND 4. Revision 1. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 18 Aug 1972. 25p. (FIND–50383(8-72)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

52423 (JAERI-M–4591) FINAL DESIGN ON THE JPDR-II PLANT. II. OUTLINE OF THE JPDR-II FACILITIES. (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 135p. (In Japanese). NTIS (U. S. Sales Only).

The specifications for equipment in the JPDR-II plant are presented in the form of lists, which were obtained by plant design. These specifications are indispensable in the future maintenance and operation of the JPDR-II plant. (auth)

52424 (JAERI-M–4608) DESIGN FOR THE JPDR-II PROJECT. Futamura, Yoshiaki; Takano, Masami; Okazaki, Yoshihito; Tachibana, Katsumi (Japan Atomic Energy Research Inst., Tokyo). Oct 1971. 141p. (In Japanese). NTIS (U. S. Sales Only).

Plant engineering, design calculations, and the final design for the JPDR-II project, which is for doubling the power of JPDR, are described. The design of JPDR included the following: conceptional, basic and detail designs, coordination among the various design groups, and adjusting the design to the existing JPDR. (Japan)

52425 (TID–8200(26th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1972. (Office of the Assistant General Manager for Energy and Development (AEC), Washington, D. C. (USA)). 1972. 37p. Dep. NTIS.

Information is tabulated on nuclear reactor and critical assembly facilities in operation, shutdown, under construction, or planned. Data are included on name, location, type, power, and startup date. (H.D.R.)

52426 ROLE OF NUCLEAR POWER IN THE USSR. Peer, V. A. Energiewirt. Tagesfragen: 22: No. 1-2, 45-6(1972). (In German).

A short review is given on the present state including the specifications of the nuclear power plants in operation, under construction, or in the planning stage, as well as a forecast of the energy supply of the world and of the USSR. (INIS)

52427 NUCLEAR FUEL CYCLE INSURANCE REQUIREMENTS. Holt, W. A. (Marsh and McLennan, New York). Health Phys.; 23: No. 3, 349-54(Sep 1972).

A review of the domestic Nuclear Insurance Pools is presented in order to understand how nuclear liability and nuclear property coverage is obtained and applied. Support activities such as environmental surveys, safety surveys, radiation exposure records and over-all plant knowledge are presented from the view point of loss prevention and the relationship to the nuclear insurance inspection program. The projected increase in the nuclear industry will place a greater emphasis on the health physicist and his emphasis on radiation safety. The extent of dollar losses due to radiation and contamination are directly related to the participation of the health physicist. (auth)

Containment Systems, Waste Processing, and Radiation Protection

Refer also to abstract 50436.

52428 CONCRETE SHIELDS IN THE RHEINSBERG NUCLEAR POWER PLANT. Gerullis, W.; Michaelis, U. E. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 15: No. 1, 9-22(Jan 1972). (In German).

During erection of the Rheinsberg nuclear power plant large-scale experience was gained in fabricating and proving different shielding concretes in the German Democratic Republic. Measurements on concrete shields and operational experience for more than 5 years show the shielding concretes used to meet the technical requirements made. (auth)

Coolant System

Refer also to abstract 51113.

52429 SAFETY CONCEPTS AND EMERGENCY CORE COOLING FOR A BWR. Koch, E.; Sack, L. (AEG-Telefunken, Frankfurt am Main). Nucl. Eng. Int.; 17: No. 193, 483-7(Jun 1972).

The emergency core cooling systems adopted for BWRs with internal axial pumps such as the Brunsbüttel Station are described. An outline is given of the systematic development work towards a reactor with optimized emergency core cooling capability. Dynamic loads on a reactor during a loss-of-coolant accident are discussed. (UK)

52430 COOLING-GAS CIRCULATORS FOR NUCLEAR-POWER STATIONS. Fraser, William Milton; Cairns, Walter John; McDonald, Ian Norman (to James Howden and Co. Ltd.). U. S. Patent 3,671,149. 20 Jun 1972. Filed 9 Oct 1968.

A circulator for the pressurized gas in the cooling circuit of a nuclear power station is of a kind having an electric motor withdrawably mounted in a wall-mounted pressure vessel, and a motor-driven gas blower in the gas space at the inner end of the vessel. Provision is made for isolating the inner end of the vessel from the reactor to enable withdrawal of the blower with the motor, the isolating means including an axially reciprocable ring closing an annular gap between the blower casing and ducting in the gas space, and an axially reciprocable dome in the gas space, the ring engaging the vessel and the dome engaging the ring to effect sealing of the vessel from the reactor. (Official Gazette)

Fuels and Fuel Elements

52431 ARTICULATED FUEL ELEMENT HOUSING. Bernath, Louis; Facha, Joseph V. (to North American Rockwell Corp.). U. S. Patent 3,671,394. 20 Jun 1972. Filed 29 Dec 1969.

Described is an articulating ball joint integral with and near the base of a plurality of nuclear reactor fuel elements to compensate for bowing distortions and stresses. This joint allows for a slight misalignment, minimizing component stresses in the housing of each of the fuel elements. (Official Gazette)

52432 INTERNALLY PRESSURIZED FUEL ELEMENT. Ferrari, Harry M. (to Westinghouse Electric Corp.). U. S. Patent 3,677,894. 18 Jul 1972. Filed 14 Aug 1969.

A fuel element for a pressurized reactor comprises a sealed cladding case, nuclear fuel therein and means for producing an internally pressurized atmosphere so that the fuel element is free standing. It is also characterized by metal wall cladding having a reduced thickness for conditions of reactor use. Several methods are given for pressurizing the fuel element. The relationship between pressure and void volume is discussed. (Official Gazette)

52433 NUCLEAR REACTOR MEANS FOR MINIMIZING LATERAL VIBRATIONS. Jones, Philip Michael; Walsh, Raymond Herbert (to United Kingdom Atomic Energy Authority). U. S. Patent 3,674,636. 4 Jul 1972. Priority date 23 Nov 1967, Great Britain.

Lateral vibrations of a component (such as a fuel stringer or a control rod) when subjected to coolant flow in a channel of a gas-cooled reactor core structure during lifting and lowering of the component from and into the channel are minimized by the provision of radially projecting spring bristles at the lower end of the component, the bristles being of a length so as to locate the lower end of the component by engagement with the channel wall. (Official Gazette)

52434 FUEL ELEMENT FOR A NUCLEAR REACTOR. Turner, R. F.; Nehrig, D. A.; Leon, H. I. (to Gulf Oil Corp.). German Patent 1,564,010. 13 Jan 1972. (In German).

A description is given of a fuel element consisting of at least one part having the following features: between two cylindrical moderator elements forming a cylindrical annular clearance, the nuclear fuel (coated fuel particles) is embedded in axially symmetrical distribution. The hollow space inside the inner cylinder is partially filled with moderator material having a polygonal cross section, with the remaining space forming channels for the coolant flow. If more than one element is used, the elements are tightly connected to each other and can be moved along the axis of the moderator rod. (GF)

52435 NUCLEAR FUEL ASSEMBLY. Delafosse, Jacques; Viaud, Jean-Luc (to Commissariat a l'Energie Atomique). British Patent 1,274,405. 17 May 1972. Priority date 6 May 1970, France.

A fuel assembly is designed which can be used in a water-moderated and -cooled reactor or a sodium-cooled reactor. The assembly comprises a cluster of canned fuel rods retained by a bottom end plate and spacing grids. The bottom end plate is connected to a top end plate by tie rods of same diameter as the fuel rods and of a quantity equal to one tenth of the fuel rod number.

Movement of the spacing grids is limited by tubular struts (stops) sliding on some of the tie rods, which also form part of the control elements. A particular embodiment is described in detail for a pressurized-water reactor. Details of tie rod design may be found in British Patent 1,204,657. (D.L.C.)

52436 NUCLEAR FUEL ROD SUPPORTING ARRANGEMENTS. Jabsen, Felix S. (to Babcock and Wilcox Co.). U. S. Patent 3,665,586. 30 May 1972. Filed 7 Nov 1968.

A description is given of a combination of a frame for holding a fuel rod in place within a reactor. The frame includes at least one open-ended cell which forms a passageway within which the member may be held and resilient means for holding the member within the passageway, and means for temporarily enlarging the passageway to enable the member to be freely moved within the passageway. In addition, there is provided a method of assembling a nuclear fuel rod with a grid structure of this type wherein the improvement comprises temporarily deflecting the resilient means to allow the fuel rod to be moved within the grid structure without being fretted thereby. (Official Gazette)

Auxiliary Systems and Engineered Safeguards

52437 (DUN-SA-182) LIQUID FLOW CONTROL SYSTEM. Davis, Harold S. (Douglas United Nuclear, Inc., Richland, Wash.). 28 Sep 1971. 19p. (CONF-711022-2). Dep. NTIS.

From second annual thermal power and eighth biennial hydraulics conference; Pullman, Wash. (5 Oct 1971).

A liquid flow control system is described which provides for the instant and automatic substitution of an emergency supply of liquid for a normal supply of liquid when the normal supply is inadequate, while preventing the two liquids from mixing during normal operation. The two supplies of liquid are connected by an inverted U-tube extending above the highest level the normal supply can reach. An air pocket at the top of the inverted U-tube prevents mixing of the two liquids in normal operation. When the normal supply is exhausted, the air pocket is vented to the atmosphere, causing the emergency supply to flow through the U-tube supplementing the normal supply. (auth)

52438 (GULF-GA-A-12045) QUALIFICATION OF FORT ST. VRAIN SAFE SHUTDOWN EQUIPMENT FOR STEAM ENVIRONMENT RESULTING FROM PIPE RUPTURES. Benham, R. G.; Burwell, E. J.; Duncan, D. S.; Menzel, H. F. (Gulf General Atomic Co., San Diego, Calif.). 30 May 1972. Contract AT(04-3)-633. 325p. Dep. NTIS.

The environmental test program conducted to establish the satisfactory performance of the Fort St. Vrain power reactor shutdown cooling equipment following a steam pipe rupture is described. The analysis employed to estimate the temperature environment in the reactor and turbine buildings is presented, and the components requiring testing under the estimated temperature transient conditions are identified. Test facilities and instrumentation are described. Detailed test results for each item tested (valves, valve actuators, instruments, pumps, motors, power and control cables, and motor starters) indicate that the minimum safe shutdown equipment may be expected to be operational following the worst-case steam line rupture. (H.D.R.)

52439 (GULF-GA-A-12075) FINAL REPORT: RELIABILITY DEMONSTRATION TEST OF FORT ST. VRAIN STANDBY DIESEL GENERATOR SETS. Benham, R. G. (Gulf General Atomic Co., San Diego, Calif.); Swart, F. E. (Public Service Co. of Colorado, Denver). 19 May 1972. Contract AT(04-3)-633. 26p. Dep. NTIS.

The reliability demonstration test of the Fort St. Vrain standby diesel generator sets was initiated January 27, 1972, to satisfy requirements for an operating permit. The AEC-required 298th successful test cycle was completed on March 8, 1972. Test cycle distribution between the two diesel generator sets shows the first 255 were performed on set 1-A and the last 43 were performed on set 1-B. In addition, Public Service Company of Colorado performed 57 more test cycles on set 1-B for a total of 355 successful tests. All tests were performed in accordance with the requirements of the test specification. Records of individual test cycles are documented along with information concerning maintenance inspections or checks and evaluations of invalid test cycles. Using the test results as a basis, it is concluded that the required reliability of 0.99 at 95% confidence, for each diesel generator set, has been satisfactorily demonstrated and exceeded. (auth)

52440 METHOD AND MEANS FOR REVERSIBLY CHANGING THE BORIC ACID CONCENTRATION IN THE COOLANT OF A NUCLEAR REACTOR. Gramer, Gottfried; Wittrowsky, Gunter (to Siemens Aktiengesellschaft). U. S. Patent 3,666,626. 30 May 1972. Priority date 23 Jan 1968, Germany.

A method and means are given whereby the boric acid concentration in the primary coolant may be reversibly changed in order to compensate for excess reactivity and to enhance load follow capability. The primary coolant, or a portion thereof, may be passed through an anion exchange bed containing a basic resin. The temperature of the influent to the bed is varied so that the coolant receives additional boric acid at higher temperatures and loses boric acid at lower temperatures. (Official Gazette)

Operation and Economics

52441 (AEC-tr-7313) METHODS FOR ASSESSING NUCLEAR POWER PLANT DEVELOPMENTS, NOTABLY FAST BREEDERS. Jansen, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-1066. 533p. Dep. NTIS.

The purpose of the study is to make available an up-to-date set of tools for judging long-term decisions in the development of fast breeder reactors. This enables a judgement of the development tendencies of nuclear power stations in the Federal Republic of Germany. Particular emphasis is laid on a description of the problems associated with models forming the basis of decision preparation, and it is attempted to provide an input for subjective weighting and forecasting factors to the methods of analysis offered. An investigation is presented of special economic problems associated with high performance breeders which result in a new comprehensive criterion of Fast Breeder optimization. The price of plutonium is analyzed. An applied systems analysis of the situation of nuclear energy in the Federal Republic of Germany for the coming decades is presented. Special significance is assigned to the discussion of the problem of satisfying or reducing the demand with respect to the amount of separative work required to enrich uranium for some types of nuclear power stations. Useful alternatives are finally outlined with the inclusion of export possibilities and political aspects. (auth)

52442 (DLCS-5000172) SHIPPINGPORT ATOMIC POWER STATION. Quarterly Operating Report, First Quarter 1972. (Duquesne Light Co., Shippingport, Pa.). 1972. Contract AT(11-1)-292. 25p. Dep. NTIS.

The operations and maintenance requirements for the Shippingport Pressurized-Water Reactor during January to March 1972 are reviewed. (D.C.C.)

52443 (DOCKET-50016-167) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for May 1972. (Power Reactor Development Co., Detroit, Mich.). 29 Aug 1972. 15p. (PRDC-EF-105). Dep. NTIS.

52444 (DOCKET-50016-168) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Order to Show Cause has been Evaluated and Notice of Hearing is Issued. (Directorate of Licensing (AEC), Washington, D. C.). 28 Aug 1972. 4p. Dep. NTIS.

A notice of public hearing is presented concerning the extension of the operating license for the Fermi Fast Breeder Reactor. (D.C.C.)

52445 (DOCKET-50016-169) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specification Change Request 29 Including Revision 1 Withdrawn. (Power Reactor Development Co., Detroit, Mich.). 5 Sep 1972. 1p. Dep. NTIS.

Information is presented concerning technical specifications regulating full power operation and Core A fuel. (D.C.C.)

52446 (DOCKET-50029-192) YANKEE NUCLEAR POWER STATION. Technical Specifications Violations AO-72-9 and AO-72-11. (Yankee Atomic Electric Co., Rowe, Mass.). 23 Aug 1972. 3p. Dep. NTIS.

Information is presented concerning failure of a control rod to be fully inserted into the core, and incorrect nitrogen overpressure in the safety injection accumulator. (D.C.C.)

52447 (DOCKET-50029-194) YANKEE NUCLEAR POWER STATION. Operation Report for the Month of July 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 25 Aug 1972. 12p. Dep. NTIS.

52448 (DOCKET-50029-198) YANKEE NUCLEAR POWER STATION. Control Rod Drop Times. (Yankee Atomic Electric Co., Westboro, Mass.). 31 Aug 1972. 8p. Dep. NTIS.

52449 (DOCKET-50155-121) BIG ROCK POINT NUCLEAR PLANT. Sixteenth Semiannual Report of Operations, January 1–June 30, 1972. (Consumers Power Co., Jackson, Mich.). 30 Aug 1972. 41p. Dep. NTIS.

52450 (DOCKET-50155-122) BIG ROCK POINT NUCLEAR PLANT. Special Report No. 13, Containment Leak Rate Test, 1972. (Consumers Power Co., Jackson, Mich.). 1 Sep 1972. 31p. Dep. NTIS.

52451 (DOCKET-50206-166) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Unit Tripped on July 29, 1972 at 133 Percent Overspeed. (Southern California Edison Co., Rosemead, Calif.). 28 Aug 1972. 2p. Dep. NTIS.

52452 (DOCKET-50213-156) HADDAM NECK PLANT, UNIT 1. Operation Report No. 72-7 for the Month of July 1972. (Connecticut Yankee Atomic Power Co., Haddam). 30 Aug 1972. 24p. (NYO-3144-74). Dep. NTIS.

52453 (DOCKET-50219-211) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Outside Radwaste Tank Activity. (Jersey Central Power and Light Co., Morristown, N. J.). 28 Aug 1972. 2p. Dep. NTIS.

52454 (DOCKET-50220-106) NINE MILE POINT NUCLEAR STATION, UNIT 1. Semiannual Report of Operation, January 1, 1972–June 30, 1972. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 25 Aug 1972. 38p. Dep. NTIS.

52455 (DOCKET-50244-117) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Fifth Semiannual Report, December 16, 1971–June 25, 1972. (Rochester Gas and Electric Corp., N. Y.). 24 Aug 1972. 31p. Dep. NTIS.

52456 (DOCKET-50245-153) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Menhaden Fish Mortalities in Circulating Water Discharge. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 10 Aug 1972. 2p. Dep. NTIS.

52457 (DOCKET-50245-154) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-72-20. (Millstone Point Co., Hartford, Conn.). 16 Aug 1972. 2p. Dep. NTIS.

Information is presented concerning the incorrect trip settings for isolation condenser flow switches. (D.C.C.)

52458 (DOCKET-50245-155) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. License DPR-21, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 22 Aug 1972. 2p. Dep. NTIS.

Temporary waiver of technical specifications is presented concerning the maintenance of control rod drives while the torus is drained. (D.C.C.)

52459 (DOCKET-50250-89) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence AO-3-72-3. (Florida Power and Light Co.). 18 Aug 1972. 1p. Dep. NTIS.

Information is presented concerning the malfunction of the bus breaker for the emergency diesel generator. Corrective actions are described. (D.C.C.)

52460 (DOCKET-50250-90) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence AO-3-72-4. (Florida Power and Light Co.). 25 Aug 1972. 2p. Dep. NTIS.

Information is presented concerning the malfunction of the component cooling water pump breaker. Corrective actions are described. (D.C.C.)

52461 (DOCKET-50250-91) TURKEY POINT PLANT, UNIT 3. Containment Integrity During the Precritical Test Period. (Florida Power and Light Co.). 25 Aug 1972. 1p. Dep. NTIS.

52462 (DOCKET-50255-98) PALISADES PLANT. Semiannual Operations Report No. 3, January 1–June 30, 1972. (Consumers Power Co., Jackson, Mich.). 30 Aug 1972. 40p. Dep. NTIS.

52463 (DOCKET-50263-145) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. High Pressure Coolant Injection Operating Experience Information. (Northern States Power Co., Minneapolis, Minn.). 25 Aug 1972. 3p. Dep. NTIS.

52464 (DOCKET-50263-146) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Notice of Consideration of Conversion of Provisional Operating License to a Full-Term Operating License. (Directorate of Licensing (AEC), Washington, D. C.). 18 Aug 1972. 8p. Dep. NTIS.

52465 (DOCKET-50263-147) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of Main Steamline Drain Valve to Close. (Northern States Power Co., Minneapolis, Minn.). 28 Aug 1972. 1p. Dep. NTIS.

52466 (DOCKET-50263-148) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Steps Taken to Correct the Item of Apparent Noncompliance Brought to Attention in Letter Dated July 31, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 7 Sep 1972. 7p. Dep. NTIS.

Requested information is presented concerning the operating status of drywell pressure instrument channels. (D.C.C.)

52467 (DOCKET-50265-108) QUAD-CITIES STATION, UNIT 2. Slow Closure of a Main Steamline Isolation Valve. (Commonwealth Edison Co., Cordova, Ill.). 25 Aug 1972. 2p. Dep. NTIS.

52468 (DOCKET-50265-110) QUAD-CITIES STATION, UNIT 2. Malfunction of Vacuum Breakers from Suppression Chamber to Drywell. (Commonwealth Edison Co., Cordova, Ill.). 29 Aug 1972. 1p. Dep. NTIS.

52469 (DOCKET-50265-111) QUAD-CITIES STATION, UNIT 2. Details of Jet Pump Failure, August 20, 1972. (Commonwealth Edison Co., Cordova, Ill.). 30 Aug 1972. 2p. Dep. NTIS.

52470 (DOCKET-50266-77) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Technical Specifications, Change 3. (Directorate of Licensing (AEC), Washington, D. C.). 22 Aug 1972. 2p. (DOCKET-50301-68). Dep. NTIS.

Revised technical specifications are presented concerning maintenance of the service water pumps during reactor operation. (D.C.C.)

52471 (DOCKET-50266-78) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Operation Report No. 4, January 1–June 30, 1972. (Wisconsin Electric Power Co., Milwaukee. Wisconsin Michigan Power Co., Appleton, Wis.). 28 Aug 1972. 51p. (DOCKET-50301-69). Dep. NTIS.

52472 (DOCKET-50271-98) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence AO-72-02. (Vermont Yankee Nuclear Power Corp., Rutland). 25 Aug 1972. 4p. Dep. NTIS.

Information is presented concerning the failure of drywell pressure switches. (D.C.C.)

52473 (DOCKET-50271-99) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence AO-72-03. (Vermont Yankee Nuclear Power Corp., Rutland). 23 Aug 1972. 2p. Dep. NTIS.

Information is presented concerning the incorrect installation of sensing lines for steam flow indicators and pressure indicators. Corrective actions are described. (D.C.C.)

52474 (DOCKET-50282-70) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Operating License Application, Amendment 21. (Northern States Power Co., Minneapolis, Minn.). 25 Aug 1972. 36p. (DOCKET-50306-67). Dep. NTIS.

Estimated operating costs for the Prairie Island Power Reactor Units 1 and 2 are presented. Financial data on the owners of the reactors are included. (D.C.C.)

52475 (DOCKET-50315-73) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Application for Operating License, Amendment 29. (Indiana and Michigan Power Co., New York). 29 Aug 1972. 78p. (DOCKET-50316-73). Dep. NTIS.

Estimated operating costs for the Donald C. Cook Power Reactor Units 1 and 2 are presented. Financial data on the owners of the reactors are included. The 1971 Annual Report for the Indiana and Michigan Power Company is presented. (D.C.C.)

52476 (DOCKET-50397-25) HANFORD NO. 2 NUCLEAR POWER PLANT. Application for Construction Permit, Amendment 10. (Washington Public Power Supply System, Richland). 21 Aug 1972. 6p. Dep. NTIS.

Revised cost estimates for the construction of the Hanford Power Reactor Unit 2 are presented. (D.C.C.)

52477 (DOCKET-50409–10) LA CROSSE BOILING WATER REACTOR. Report of Operating Condition. (Dairyland Power Cooperative, La Crosse, Wis.). 16 Aug 1972. 5p. Dep. NTIS.

Procedures are described for maintaining reactor operating conditions with a linking control rod drive hydraulic scram system. (D.C.C.)

52478 (DOCKET-50409–11) LA CROSSE BOILING WATER REACTOR. Buildup of Radioiodine Concentration in Primary Water After Shutdown. (Dairyland Power Cooperative, La Crosse, Wis.). 22 Aug 1972. 2p. Dep. NTIS.

52479 (DUN-SA–174) HANFORD RECERTIFICATION IN RESPONSE TO NEW AEC DIRECTIVE. Edwards, T. E. (Douglas United Nuclear, Inc., Richland, Wash.). 11 Aug 1971. 12p. (CONF-710808–1). Dep. NTIS.

From Conference on reactor operating experience; Denver, Colo. (8 Aug 1971).

The program development for recertification of N Reactor operating personnel is described. The training methods and results of recertification of 6 supervisors are discussed. (H.D.R.)

52480 (TID–25857, pp 57–71) NUCLEAR POWER PLANTS: PRESENT, PAST, AND FUTURE. Thompson, Theos J. (Atomic Energy Commission, Washington, D. C.). 1972.

In Environmental and ecological forum, 1970–1971.

Predicted power requirements for the U. S. are presented. The existing types of power reactors are described. The development of the fast breeder power reactor is discussed. Thermal and radioactive discharges from power reactors and their effects on the environment are analyzed. (D.C.C.)

52481 (WASH–1196(4-72)) NUCLEAR INDUSTRY FUEL SUPPLY SURVEY. (Division of Production and Materials Management (AEC), Washington, D. C.). Apr 1972. 13p. Dep. NTIS.

In an effort to gather and report data relating to nuclear fuel sales and fuel supply arrangements, a survey was made to gather information which reflects the situation as of January 1, 1972. Information was furnished by 54 utilities, 5 reactor manufacturers, and 18 uranium producers, covering essentially all companies involved in nuclear fuel production and use. The data cover 124 civilian nuclear power reactors (privately and publicly owned) in operation, under construction, or for which orders have been placed, having a total capacity of 105,600 megawatts electric (MW(e)). (auth)

52482 START-UP TEST ON NO. 1 NUCLEAR POWER PLANT IN THE FUKUSHIMA POWER STATION. Ikegame, Ryo; Seko, Takaya; Matsuo, Yoshio (Tokyo Electric Power Co. Inc., Fukushima, Japan). Karyoku Hatsuden; 22: No. 10, 1128-39 (Oct 1971). (In Japanese).

The Fukushima Power Station No. 1 Plant employs a boiling water reactor, its thermal output is 1380 MW, and electric output of turbo-generator is 460 MW. Construction was started in January 1967, and criticality was attained in July 1970. Start-up tests carried out for the period from July 1970 to March 1971 starting with fuel loading and ending in MITI's load test are described. The organizational personnel set-up for the start-up test is explained and the schedule of the start-up test given. Tests and results are given on the following: minimum criticality, control-rod drive, temperature coefficients, reactor-core performance, recirculation flow-rate control, recirculation pump tripping, load shut-off, control rod calibration, high-pressure water injection, radiation level, chemical measurement, and operational demonstration. Finally, scrams and maintenance required during the tests are briefed. (Japan)

Safety and Siting

Refer also to abstracts 50627, 50629, 50860, and 50861.

52483 (COO–4217-1) MATHEMATICAL MODELING OF NUCLEAR PLANT THERMAL EFFECTS IN LAKE CHAMPLAIN. McLay, R. W.; Hundal, M. S.; Martinek, F.; Henson, E. B. (Vermont Univ., Burlington). [nd]. Contract AT(30-1)-4217. 13p. (CONF-711206–1). Dep. NTIS.

From Meeting on applied mechanics aspects of nuclear effects in materials; Washington, D. C. (2 Dec 1971).

Prediction of the thermal effects of a proposed nuclear plant on Lake Champlain is made by means of mathematical models programmed for the digital computer. The models simulate the thermal effects in three distinct regions: (a) the open channel at the outfall, (b) the mixing regime immediately adjacent to the entry, and (c) the regime, at some distance from the outfall, where mass and energy exchange with environment occurs and the heated plume is driven by lake currents and wind shears. The codes are briefly discussed along with their verification. The Lake Champlain problem is simulated for cases representing the extreme and typical summer conditions and optimum winter operation. 54 references. (auth)

52484 (DOCKET-50003–123) INDIAN POINT STATION, UNIT 1. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 19 Aug 1972. 3p. Dep. NTIS.

52485 (DOCKET-50029–193) YANKEE NUCLEAR POWER STATION. Clarification of Letter Dated August 7, 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 24 Aug 1972. 1p. Dep. NTIS.

Additional information is presented concerning control rod replacement schedule and insertion times. (D.C.C.)

52486 (DOCKET-50029–195) YANKEE NUCLEAR POWER STATION. Activities That Appear to be in Noncompliance With AEC Requirements. (Division of Compliance (AEC), Newark, N. J. Region I). 26 Jun 1972. 5p. Dep. NTIS.

Information is presented concerning the installation of valves in the emergency core cooling system. (D.C.C.)

52487 (DOCKET-50029–196) YANKEE NUCLEAR POWER STATION. Wall Thickness of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52488 (DOCKET-50029–197) YANKEE NUCLEAR POWER STATION. Three Loop Loss of Coolant Analysis. (Yankee Atomic Electric Co., Westboro, Mass.). 25 Aug 1972. 4p. Dep. NTIS.

52489 (DOCKET-50130–14) PATHFINDER GENERATING PLANT. Provisional Facility License No. DPR-11, Request for Termination. (Northern States Power Co., Minneapolis, Minn.). 15 Aug 1972. 133p. Dep. NTIS.

The dismantling plan and radiation monitoring program for the Sioux Falls Power Reactor are presented. (D.C.C.)

52490 (DOCKET-50213–155) HADDAM NECK PLANT, UNIT 1. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 5p. Dep. NTIS.

52491 (DOCKET-50219–209) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Local Leakage Rate Tests. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Aug 1972. 11p. Dep. NTIS.

Results of containment system local leakage rate tests performed during September to October 1971 are presented. (D.C.C.)

52492 (DOCKET-50219–210) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Primary Containment Leakage Rate Test. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Aug 1972. 18p. Dep. NTIS.

52493 (DOCKET-50219–212) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Environmental Report, Amendment 1. (Jersey Central Power and Light Co., Morristown, N. J.). 31 Aug 1972. 78p. Dep. NTIS.

Additional information is presented concerning the cost-benefit analysis for alternate circulating water cooling system and radioactive waste disposal system. (D.C.C.)

52494 (DOCKET-50220–104) NINE MILE POINT NUCLEAR STATION, UNIT 1. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52495 (DOCKET-50220–105) NINE MILE POINT NUCLEAR STATION, UNIT 1. Action Taken to Correct the Items of Noncompliance Brought to Attention Following Inspection April 4–6 and May 16–19, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 11p. Dep. NTIS.

Additional information is presented concerning administrative procedures and personnel. (D.C.C.)

52496 (DOCKET-50244–115) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Action Taken to Correct the Items of Noncompliance Brought to Attention Following Inspection of May 11–12, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 28 Jul 1972. 7p. Dep. NTIS.

Requested information on administrative procedures is presented. (D.C.C.)

52497 (DOCKET-50244–116) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Quadrant Power Tilt Limits. (Rochester Gas and Electric Corp., N. Y.). 25 Aug 1972. 3p. Dep. NTIS.

52498 (DOCKET-50245–156) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. License DPR-21, Change 7. (Directorate of Licensing (AEC), Washington, D. C.). 28 Aug 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning offsite power sources. (D.C.C.)

52499 (DOCKET-50245–157) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Final Safety Analysis Report, Appendix G, Amendment 29. (Millstone Point Co., Hartford, Conn.). 23 Aug 1972. 155p. Dep. NTIS.

The emergency plan for the Millstone Point Power Reactor Unit 1 is presented. (D.C.C.)

52500 (DOCKET-50247–80) INDIAN POINT NUCLEAR GENERATING UNITS 2 AND 3. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 4p. (DOCKET-50286–52). Dep. NTIS.

52501 (DOCKET-50255–97) PALISADES PLANT. Predicted Minimum Time Collapse for Palisades Fuel Rods. (Consumers Power Co., Jackson, Mich.). 25 Aug 1972. 7p. Dep. NTIS.

52502 (DOCKET-50261–104) H. B. ROBINSON UNIT 2. Final Facility Description and Safety Analysis Report, Volume 1. (Carolina Power and Light Co., Raleigh, N. C.). 26 Nov 1968. 532p. Dep. NTIS.

Information is presented on the H. B. Robinson Power Reactor Unit 2 under the following broad topics: site and environment; reactor; and reactor coolant system. (D.C.C.)

52503 (DOCKET-50261–105) H. B. ROBINSON UNIT 2. Final Facility Description and Safety Analysis Report, Volume 2. (Carolina Power and Light Co., Raleigh, N. C.). 26 Nov 1968. 621p. Dep. NTIS.

Information is presented on the H. B. Robinson Power Reactor Unit 2 under the following broad topics: containment system; engineered safety features; instrumentation; and control system. (D.C.C.)

52504 (DOCKET-50261–107) H. B. ROBINSON UNIT 2. Quadrant Power Tilt Limits. (Carolina Power and Light Co., Raleigh, N. C.). 25 Aug 1972. 2p. Dep. NTIS.

52505 (DOCKET-50265–109) QUAD-CITIES STATION, UNIT 2. Item of Noncompliance Reported on During Inspections Conducted on May 31, June 2, June 6–7, and June 15, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 31 Aug 1972. 7p. Dep. NTIS.

Requested information is presented concerning the displacement measurements for the piping expansion test. (D.C.C.)

52506 (DOCKET-50269–63) OCONEE NUCLEAR STATION, UNIT 1. Ability of the Out-of-Core Detector System to Indicate Radial Tilts. (Duke Power Co., Charlotte, N. C.). 23 Aug 1972. 3p. Dep. NTIS.

52507 (DOCKET-50269–64) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 34. (Duke Power Co., Charlotte, N. C.). 25 Aug 1972. 125p. (DOCKET-50270–51; DOCKET-50287–46). Dep. NTIS.

Revised and additional data are presented on the following topics: physics measurements; site; personnel; auxiliary systems; and radioactive waste disposal. (D.C.C.)

52508 (DOCKET-50271–97) VERMONT YANKEE NUCLEAR POWER STATION. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52509 (DOCKET-50272–34) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. (DOCKET-50311–34). Dep. NTIS.

52510 (DOCKET-50275–25) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Supplement 3. (Pacific Gas and Electric Co., San Francisco, Calif.). 25 Aug 1972. 55p. (DOCKET-50323–23). Dep. NTIS.

A description of the test model for simulating the circulating water discharge structure is presented. Results of the hydraulic test are included. (D.C.C.)

52511 (DOCKET-50277–55) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment 19. (Philadelphia Electric Co., Pa.). 29 Aug 1972. 37p. (DOCKET-50278–55). Dep. NTIS.

Revised and additional data are presented on the Peach Bottom Power Reactor Units 2 and 3 under the following broad topics: core thermal hydraulics; emergency core cooling system; and protection systems. (D.C.C.)

52512 (DOCKET-50282–71) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated July 7, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 31 Aug 1972. 11p. (DOCKET-50306–68). Dep. NTIS.

Requested additional information is presented concerning cleanliness around the pressure vessel area, qualifications of nondestructive test examiner for main steam isolation valves, and radiography of piping welds. (D.C.C.)

52513 (DOCKET-50285–69) FORT CALHOUN STATION, UNIT 1. Action Taken with Respect to Determining Wall Thicknesses of Valves. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 5 Jul 1972. 7p. Dep. NTIS.

52514 (DOCKET-50286–53) INDIAN POINT NUCLEAR GENERATING UNIT 3. Steps Taken to Correct the Items of Noncompliance Brought to Attention Following Inspection on May 24–25, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 3 Aug 1972. 10p. Dep. NTIS.

Requested additional information is presented concerning the installation and inspection of electrical cables and the quality control requirements for the refueling water storage tank. (D.C.C.)

52515 (DOCKET-50293–86) PILGRIM NUCLEAR POWER STATION. Action Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 2p. Dep. NTIS.

52516 (DOCKET-50293–87) PILGRIM NUCLEAR POWER STATION. Action to be Taken to Correct the Items of Noncompliance Brought to Attention Following Inspection on July 5–6, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 11 Aug 1972. 4p. Dep. NTIS.

Additional information concerning the quality assurance program for the reactor is presented. (D.C.C.)

52517 (DOCKET-50295–60) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Steps Taken to Correct the Items of Apparent Nonconformance Brought to Attention in Letter Dated July 5, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 31 Aug 1972. 7p. (DOCKET-50304–60). Dep. NTIS.

Requested additional information is presented concerning testing requirements and quality control procedures for valves. (D.C.C.)

52518 (DOCKET-50298–49) COOPER NUCLEAR STATION. Environmental Report, Supplement 4. (Nebraska Public Power District, Columbus). 25 Aug 1972. 10p. Dep. NTIS.

Requested additional data are presented concerning chemical discharges from the reactor, site geology, and site ecosystems. (D.C.C.)

52519 (DOCKET-50302–51) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Applicant's Environmental Report, Supplements 2 and 3. (Florida Power Corp., St. Petersburg). 11 Aug 1972. 76p. Dep. NTIS.

The environmental report for the Crystal River Power Reactor Unit 3 is supplemented by the submission of revised and additional information on cost-benefit analysis for reactor operations. (D.C.C.)

52520 (DOCKET-50313–48) ARKANSAS NUCLEAR ONE, UNIT 1. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated July 27, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA).

Region II). 23 Aug 1972. 7p. (DOCKET-50368–32). Dep. NTIS.

Requested additional information is presented concerning quality assurance procedures during reactor construction. (D.C.C.)

52521 (DOCKET-50317–57) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Action Taken to Correct the Items of Nonconformance Brought to Attention Following Inspection of February 22–25, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 10 Aug 1972. 12p. (DOCKET-50318–54). Dep. NTIS.

52522 (DOCKET-50322–28) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Action Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52523 (DOCKET-50324–41) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated July 7, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 25 Aug 1972. 14p. (DOCKET-50325–42). Dep. NTIS.

Requested information is presented concerning construction procedures and quality assurance requirements. (D.C.C.)

52524 (DOCKET-50324–42) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental Report, Amendment 3. (Carolina Power and Light Co., Raleigh, N. C.). 1 Sep 1972. 8p. (DOCKET-50325–43). Dep. NTIS.

Requested additional information is presented concerning alternate plans for routing transmission lines. (D.C.C.)

52525 (DOCKET-50329–32) MIDLAND PLANT, UNITS 1 AND 2. Valve Wall Thickness. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Sep 1972. 2p. (DOCKET-50330–31). Dep. NTIS.

52526 (DOCKET-50334–32) BEAVER VALLEY POWER STATION, UNIT 1. Action Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52527 (DOCKET-50336–40) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Action Taken to Correct the Items of Nonconformance Brought to Attention Following Inspection, April 26–28, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 20 Jul 1972. 7p. Dep. NTIS.

Additional information is presented concerning quality control requirements for the pressure vessel and steam generator. (D.C.C.)

52528 (DOCKET-50336–41) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Action to be Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 4p. Dep. NTIS.

52529 (DOCKET-50338–50) NORTH ANNA POWER STATION, UNITS 1 AND 2. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated July 11, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 25 Aug 1972. 6p. (DOCKET-50339–47). Dep. NTIS.

Requested additional information is presented concerning the storage requirements for reactor protection equipment. (D.C.C.)

52530 (DOCKET-50342–9) VERPLANCK NUCLEAR FACILITY, UNITS 1 AND 2. Action to be Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 2p. (DOCKET-50343–9). Dep. NTIS.

52531 (DOCKET-50346–33) DAVIS–BESSE NUCLEAR POWER STATION. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated July 27, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 29 Aug 1972. 5p. Dep. NTIS.

Requested information is presented concerning the storage of support structures for the primary cooling system components, and the damage report for the primary coolant pump volute. (D.C.C.)

52532 (DOCKET-50346–34) DAVIS–BESSE NUCLEAR POWER STATION. Valve Wall Thickness. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Sep 1972. 2p. Dep. NTIS.

52533 (DOCKET-50354–27) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Action to be Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 2p. (DOCKET-50355–26). Dep. NTIS.

52534 (DOCKET-50358–40) WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Valve Wall Thickness. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Sep 1972. 4p. Dep. NTIS.

52535 (DOCKET-50363–36) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Action to be Taken Relating to Wall Thicknesses of Nuclear Service Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Aug 1972. 3p. Dep. NTIS.

52536 (DOCKET-50367–30) BAILLY GENERATING STATION, NUCLEAR I. Environmental Report, Amendment 3. (Northern Indiana Public Service Co., Hammond). 25 Aug 1972. 15p. Dep. NTIS.

The environmental report for the Bailly Power Reactor Unit 1 is amended by the submission of requested additional data on the cost-benefit analysis for reactor operation. (D.C.C.)

52537 (DOCKET-50382–35) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated June 28, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 23 Aug 1972. 8p. Dep. NTIS.

Requested additional information is presented concerning the quality assurance program. (D.C.C.)

52538 (DOCKET-50390–22) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct Unresolved Items Concerning Quality Assurance Program Brought to Attention in Letter Dated July 28, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 18 Aug 1972. 4p. (DOCKET-50391–22). Dep. NTIS.

52539 (DOCKET-50397–24) HANFORD NO. 2 NUCLEAR POWER PLANT. Environmental Report, Amendment 5. (Washington Public Power Supply System, Richland). 16 Aug 1972. 16p. Dep. NTIS.

Requested additional information is presented concerning thermal discharges from the reactor and cost-benefit analysis for reactor operations. (D.C.C.)

52540 (DOCKET-50397–26) HANFORD NO. 2 NUCLEAR POWER PLANT. Steps Taken to Correct Items Brought to Attention in Letter of August 4, 1972. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 8 Sep 1972. 4p. Dep. NTIS.

Requested additional information is presented concerning the quality assurance program. (D.C.C.)

52541 (FIND–50298(6-72)) FIND: COOPER NUCLEAR STATION. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 23 Jun 1972. 24p. Dep. NTIS.

Docket reports issued on the Cooper Power Reactor that have been microfiched and announced in Nuclear Science Abstracts are listed chronologically. The reports are indexed to the grid coordinates at which they appear on the microfiche sheet. (H.D.R.)

52542 (FIND–50400(6-72)) FIND: SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 30 Jun 1972. 22p. (FIND–50401(6-72); FIND–50402(6-72); FIND–50403(6-72)). Dep. NTIS.

Items issued under the Docket number for the Shearon Harris Power Reactor, Units, 1, 2, 3, and 4 that have been microfiched and announced in Nuclear Science Abstracts are listed. Items are indexed to their major headings, parts, sections, etc. and listed in chronological order. (H.D.R.)

52543 (INIS-mf–160, pp 76-108) PLANNING AND MANAGEMENT OF ENVIRONMENTAL POLLUTION CONTROL AT TARAPUR NUCLEAR POWER STATION SITE. Bhat, J. S. (Bhabha Atomic Research Centre, Bombay (India)). 1971. (CONF-700847–1). INIS.

From Seminar on pollution and human environment; New Delhi, India (26 Aug 1970).

The setting up of the Environmental Survey Laboratory (ESL) at

Tarapur, India, and the studies carried out by its personnel on the problems of environmental surveillance of radioactivity from nuclear power plants have been reported. The studies started even before the plant was put into operation and continued after it went into operation. The base level and variation of activity, its dilution rate in the environment, indicator samples, demographic studies and acceptable contamination levels were some of the factors evaluated during the course of these investigations. Indicator samples like goat thyroid for radioiodine contamination of the land environment and sea weed "Sargasum" for radioiodine in the marine environment were found to be helpful in checking the increase in the environmental activity. Maximum permissible concentration limits (MPC), when evaluated, were found to be too low to be of practical application in monitoring. Hence, the concept of limiting indicator concentration (LIC) was introduced. These values have been tabulated for a few indicators. Marine and land environment studies, measurement of body radioactivity before and during operational periods, revealed that the present ^{137}Cs level in site sea water has gone up by a factor of five. It is still negligibly small compared to MPC limits. The ^{131}I contamination in coastal waters could be traced up to 16 km on either side of the site, but the levels were still quite low compared to MPC level. The limiting silt radioactivity concentration for Tarapur environment has been evaluated as 300 pCi/g and the present silt activity levels are 15 to 30 times lower than the limiting concentration. The land and air samples have also been collected and analysed periodically, both from site and from the colony, where the personnel of the plant live. In no case is the activity found to be greater than the safety limits prescribed. (INIS)

52544 (NP-19341) NUCLEAR POWER PLANT AT BRENNTANGEN. (Institutt for Atomenergi, Kjeller (Norway)). [nd]. 151p. (In Norwegian). Dep. NTIS (U. S. Sales Only).

The proposed nuclear power plant site at Brenntangen in the Østfold county on the east side of Oslofjord is the subject of a reactor safety evaluation. BWR and PWR type reactors are considered, and 5 stipulated accidents including loss of coolant and design basis accident are evaluated for each with respect to release of fission products to the surroundings. The release of radioactive waste to the atmosphere during normal operation is also analyzed for each type of reactor. The proposed site is based on underground containment, but no allowance is made for possible advantages therefrom. It is concluded that there are no limitations in the proposed site to the location of a BWR or a PWR with the usual safety systems. (Norway)

52545 (TID-25857) ENVIRONMENTAL AND ECOLOGICAL FORUM, 1970-1971. (Environmental and Ecological Forum, Rockville, Md.). 1972. 194p. Dep. NTIS.

Separate abstracts are included for each of the 12 papers presented on power reactors and the environment. (D.C.C.)

For abstracts of individual papers see: 50584, 50616, 50627, 50859—50861, 50924, 52480, and 52546—52549.

52546 (TID-25857, pp 131-43) NUCLEAR POWER INFORMATION COMMUNICATION PREDICAMENT. Costagliola, F. (General Physics Corp., Columbia, Md.). 1972.

In Environmental and ecological forum, 1970-1971.

The safety aspects of power reactors are described. Correct and incorrect information concerning the benefits and risks involved with power reactors is discussed. (D.C.C.)

52547 (TID-25857, pp 144-55) NUCLEAR POWER LICENSING: RISK-BENEFIT DETERMINATIONS AND THE PUBLIC INTEREST. Green, Harold P. (George Washington Univ., Washington, D. C.). 1972.

In Environmental and ecological forum, 1970-1971.

Licensing procedures for U. S. power reactors are described. Benefits and risks involved with power reactor operation are analyzed. (D.C.C.)

52548 (TID-25857, pp 156-60) NUCLEAR POWER: YOU NEVER HAD IT SO GOOD. Whipple, G. Hoyt (Univ. of Michigan, Ann Arbor). 1972.

In Environmental and ecological forum, 1970-1971.

The safety aspects of power reactors are discussed. The benefits and risks involved with power reactor operation are analyzed. (D.C.C.)

52549 (TID-25857, pp 161-7) BENEFITS AND COSTS OF NUCLEAR POWER. Novick, Sheldon. 1972.

In Environmental and ecological forum, 1970-1971.

A comparison of the benefits and risks involved with the operation of power reactors is presented. (D.C.C.)

52550 (WASH-1218) ATOMIC SAFETY AND LICENSING APPEAL BOARD ISSUANCES THROUGH JUNE 1972. (Atomic Energy Commission, Washington, D. C. Atomic Safety and Licensing Appeal Board). Jul 1972. 454p. Dep. NTIS.

Memoranda and orders issued by the Atomic Safety and Licensing Appeal Board concerning power reactor, research reactor, and fuel fabrication facilities are presented. (H.D.R.)

Steam and Power Conversion System

52551 (GULF-GA-A-10833) FORT ST. VRAIN HTGR STEAM GENERATOR AIR FLOW TEST. Kaufman, J. S. (Gulf General Atomic Co., San Diego, Calif.). 2 Jun 1972. Contract AT(04-3)-633. 115p. Dep. NTIS.

The Fort St. Vrain (FSV) Steam Generator Air Flow Test was a full scale test of a production steam generator for the FSV 330-MW(e) High-Temperature Gas-Cooled Reactor (HTGR) plant. The test objectives were to verify that flow-induced vibration of tubes would be within acceptable limits, and to verify that gas side heat transfer and pressure drop coefficients would be as predicted. The steam generator module was instrumented during fabrication at the General Iron Works shop in Denver, Colorado, and shipped to San Diego, where a site was specially constructed for testing. The flow modeling is described. Air was used to simulate helium which is the primary reactor coolant. Test results are compared with analytical predictions for both the vibration and heat transfer series. 5 references. (auth)

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 51072, 51075, 51128, and 52599.

52552 (LA-2585) INTEGRAL NEUTRON AND GAMMA DOSE MEASUREMENTS ON KIWI A-THREE. Worman, F. C. V.; Ballinger, E. R.; Harris, P. S. (Los Alamos Scientific Lab., N. Mex.). 15 Jul 1961. Contract W-7405-eng-36. 35p. Dep. NTIS.

Integral gamma dose and integral neutron flux and dose measurements made on Kiwi A-3 are reported. These include results from data obtained on Experimental Plans 212, 216A and 216B. Adequate results were derived from nearly every instrumented station. The gamma dose, in air, on 216B ranged from 9.60×10^5 rads at Station 19, located above the door of the privy of the reactor, to 32 rads at 1,500 feet. The penthouse wall transmission was 6×10^{-4} for gamma rays and 1.6×10^{-4} for fast neutron dose. Thermal neutron fluxes ranged from five times the total neutron flux near the reactor to one-half the fast flux at 1,500 feet. Scattering measurements made at large distances from the test cell (acting as a shadow shield) indicated that 25% of the gamma dose came from scatter, whereas 70% of the fast neutron dose was due to this source. (auth)

52553 (LA-3283) POWER DENSITY ASYMMETRIES IN COUPLED-CORE REACTOR SYSTEMS. Seale, R. L. (Los Alamos Scientific Lab., N. Mex.). Sep 1964. Contract W-7405-eng-36. 10p. Dep. NTIS.

A study of power asymmetry in the cores of a two-core KIWI-B3 cluster is presented. The results indicate that for a coupling coefficient of 0.0006 (8¢), a maximum asymmetry of about 2.2% exists on the outer edge of the fueled region nearest the neighboring core of the array. This asymmetry should be proportional to the value of the coupling coefficient. Thus, for cores having less coupling, it should decrease. (auth)

52554 (LA-3308) THERMAL AND FLOW PERFORMANCE ANALYSIS OF THE KIWI-B-4E REACTOR. McClary, J. A.; Brown, D. W.; England, H. R. (Los Alamos Scientific Lab., N. Mex.). 10 May 1965. Contract W-7405-eng-36. 50p. Dep. NTIS.

Typical test data from the two full-power reactor tests of Kiwi-B-4E-301 are presented; methods and results of the analysis and comparisons with the data are discussed. Full-power reactor system performance parameters — nozzle chamber temperature and pressure, propellant flow rate, and power levels — are related to each other, and the consistency of their relationship is verified by analysis. Methods for calculating transient reactor flow rate and thermal power are presented. Accurate correlations are presented for the nozzle coolant temperature rise and pressure drop from the test data. Calculated distributions of gas temperatures and flow between the unfueled core support and fuel channels are presented. The correspondence between calculated fuel temperatures and thermocouple indications is discussed. Calculated individual fuel channel temperatures are given based on measured fission density, and the observed effects of radiation damage on low temperature graphite thermal conductivity are analyzed. (auth)

52555 (LA-3317) STRESS ANALYSIS AND STATIC TESTING OF KIWI GRAPHITE REFLECTOR CYLINDER STRUCTURES. Neudecker, J. W. (Los Alamos Scientific Lab., N. Mex.). 1 Jun 1965. Contract W-7405-eng-36. 33p. Dep. NTIS.

The graphite reflector cylinder was an important structural component of the Kiwi-B-4D and B-4E configuration nuclear rocket reactors. Structurally, it transmitted the core axial pressure drop load from the core support plate to the nozzle skirt; fluid dynamically, it served as a flow boundary between the reflector system and the core; and neutronically, it contributed to the radial reflector-moderator system. The structural design, analysis, and hydrostatic testing of the graphite reflector cylinders are described. The following unique applications are described: (a) Structures of a nonhomogeneous and brittle material (graphite) can be used in large sizes as primary load carrying structures. (b) The structural behavior of these components can be predicted by using suitable modifications of existing stress analysis techniques and electronic computer methods, particularly in the evaluation of the thermal stresses. (auth)

52556 (LA-3577(Suppl.)) MONTE CARLO CALCULATION OF THE GAMMA-RAY HEATING IN A PHOEBUS 1 NOZZLE FROM CORE SOURCES. Watson, C. W. (Los Alamos Scientific Lab., N. Mex.). May 1967. Contract W-7405-eng-36. 12p. Dep. NTIS.

The results of a Monte Carlo calculation of core-gamma heating rates and fluxes in a Phoebus 1 nozzle and nozzle-pressure vessel interface area are presented. (auth)

52557 (LAMS-2470) KIWI-B HEAT EXCHANGER AND NEUTRONICS: DYNAMICS ANALYSIS. Mohler, R.; Erickson, P.; Wheatley, E.; Farmer, O. (Los Alamos Scientific Lab., N. Mex.). 27 Jan 1960. Contract W-7405-eng-36. 24p. Dep. NTIS.

52558 (LAMS-2695) KIWI-B1A GAMMA DOSE RATE MEASUREMENTS. Lee, P. K.; Schweitzer, W. H.; Harris, P. S. (Los Alamos Scientific Lab., N. Mex.). 2 Mar 1962. Contract W-7405-eng-36. 34p. Dep. NTIS.

Gamma dose rate measurements were made during Experimental Plans 5, 5A, 6, and 6A of the Kiwi-B1A reactor. The primary detector station was located sixty feet south of the reactor. At this location, maximum dose rates of 9.1×10^3 R/min were obtained during the peak power of the reactor. (auth)

52559 (LAMS-2774) SOME ROVER NEUTRONICS STUDIES. Mills, C. B. (Los Alamos Scientific Lab., N. Mex.). 5 Oct 1962. Contract W-7405-eng-36. 36p. Dep. NTIS.

Neutronic characteristics of the nuclear powered rocket reactor are studied by multigroup numerical methods in the following order. First, several simple critical experiments with a large variation of $C/^{235}U$ and $BeO/^{235}U$ show that the neutron cross sections are adequate for reactor studies. Second, a simple gas scattering model for thermal neutron scattering cross sections is shown by calculation to agree with experiment for a variation in reactor temperatures and so to be useful for Rover neutronics. Third, control rod effects on fission density and kinetic constants are computed for two of the Rover reactors using a 2-dimensional (x,y) transport code. 16 references. (auth)

52560 (N-72-15604) EMERGENCY COOLING ANALYSIS FOR THE LOSS-OF-COOLANT MALFUNCTION. Peoples, John A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1972. 33p. (NASA-TM-X-2464; E-6520). NTIS.

The dynamic response of a conceptual space power fast-spectrum lithium cooled reactor to the loss of coolant malfunction and several emergency cooling concepts are examined. The results show that, following the loss of primary coolant, the peak temperatures of the center most 73 fuel elements can range from 2556°K to the region of the fuel melting point of 3122°K within 3600 seconds after the start of the accident. Two types of emergency aftercooling concepts were examined: (1) full core open loop cooling and (2) partial core closed loop cooling. The full core open loop concept is a one pass method of supplying lithium to the 247 fuel pins. This method can maintain fuel temperature below the 1611°K transient damage limit but requires a sizable 22,680-kilogram auxiliary lithium supply. The second concept utilizes a redundant internal closed loop to supply lithium to only the central area of each hexagonal fuel array. By using this method and supplying lithium to only the triflute region, fuel temperatures can be held well below the transient damage limit. (auth) (STAR)

52561 (N-72-15606) ANALYSIS OF LOSS-OF-COOLANT ACCIDENT FOR A FAST-SPECTRUM LITHIUM-COOLED NUCLEAR REACTOR FOR SPACE-POWER APPLICATIONS. Turney, George E.; Petrik, Edward J.; Kieffer, Arthur W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1972. 35p. (NASA-TM-X-2483; E-6571). NTIS.

A two-dimensional, transient, heat-transfer analysis was made to determine the temperature response in the core of a conceptual space-power nuclear reactor following a total loss of reactor coolant. With loss of coolant from the reactor, the controlling mode of heat transfer is thermal radiation. In one of the schemes considered for removing decay heat from the core, it was assumed that the 4π shield which surrounds the core acts as a constant-temperature sink (temperature, 700°K) for absorption of thermal radiation from the core. Results based on this scheme of heat removal show that melting of fuel in the core is possible only when the emissivity of the heat-radiating surfaces in the core is less than about 0.40. In another scheme for removing the after-heat, the core centerline fuel pin was replaced by a redundant, constant temperature, coolant channel. Based on an emissivity of 0.20 for all material surfaces in the core, the calculated maximum fuel temperature for this scheme of heat removal was 2840°K, or about 90°K less than the melting temperature of the UN fuel. (auth) (STAR)

52562 (N-72-15608) SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM. (Aerojet-General Corp., Azusa, Calif.). Nov 1971. Contract NAS3-13458. 466p. (NASA-CR-1907). NTIS.

The SNAP-8 program has developed the technology base for one class of multikilowatt dynamic space power systems. Electrical power is generated by a turbine-alternator in a mercury Rankine-cycle loop to which heat is transferred and removed by means of sodium-potassium eutectic alloy subsystems. Final system overall criteria include a five-year operating life, restartability, man rating, and deliverable power in the 90 kW(e) range. The basic technology has been demonstrated by more than 400,000 hours of major component endurance testing and numerous startup and shutdown cycles. A test system, comprised of developed components, delivered up to 35 kW(e) for a period exceeding 12,000 hours. The SNAP-8 system baseline is considered to have achieved a level of technology suitable for final application development for long-term multikilowatt space missions. (auth) (STAR)

52563 (N-72-16519) 640-FOOT-PER-SECOND IMPACT TEST OF A TWO-FOOT-DIAMETER-MODEL NUCLEAR-REACTOR CONTAINMENT SYSTEM WITHOUT FRACTURE. Puthott, Richard L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1971]. 20p. (NASA-TM-X-67997; E-6745). NTIS.

An impact test was conducted on an 1142 pound 2 foot diameter sphere model. The purpose of this test was to determine the feasibility of containing the fission products of a mobile reactor in an impact. The model simulated the reactor core, energy absorbing gamma shielding, neutron shielding and the containment vessel. It was impacted against an 18,000 pound reinforced concrete block. The model was significantly deformed and the concrete block demolished. No leaks were detected nor cracks observed in the model after impact. (auth) (STAR)

52564 (N-72-16520) ANALYSIS OF DASHPOT PERFORMANCE FOR ROTATING CONTROL DRUMS OF A LITHIUM-COOLED FAST-REACTOR CONCEPT. Wenzler, C. J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1972. 25p. (NASA-TM-X-67992; E-6734). NTIS.

A dashpot was incorporated in the design of the drive train of the rotating control drum to prevent shock damage to the control drum and drive train at the termination of a scram action. A rotating vane dashpot using reactor coolant lithium as a damping fluid appears to be the best candidate of the various damping devices explored. A performance analysis, results and discussion of vane type dashpots are presented. (auth) (STAR)

52565 (NAA-SR-6312) SNAP 2 POWER CONVERSION SYSTEM. CRU V DESIGN. Topical Report No. 20. (Thompson Ramo Wooldridge Inc., Cleveland, Ohio. TAPCO Div.). 31 May 1963. Contract AT(11-1)-Gen-8. 202p. (TRW-ER-5375). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

CRU V design and development was undertaken to provide a SNAP 2 turbo-alternator package that will meet SNAPSHOT flight objectives. The selection of the design concept, CRU detail design features, performance estimates and the plumbing module design are described. The layout design described fulfills the majority of the specific CRU V design objectives. Potential problems are discussed but they are not considered to jeopardize accomplishment of SNAP 2 program objectives. (14 references) (auth)

52566 (NAA-SR-6317) SNAP 2 POWER CONVERSION SYSTEM. THREE-PHASE ALTERNATOR ELECTRICAL DESIGN AND PERFORMANCE TESTING. Topical Report No. 25. Reineks, Z. L. (Thompson Ramo Wooldridge Inc., Cleveland, Ohio. TRW Electromechanical Div.). 15 Oct 1964. Contract AT(11-1)-Gen-8. 52p. (TRG-ER-5412). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

The CRU V design and development program was directed toward elimination of inadequacies noted in CRU III and CRU IV designs and toward development of a combined rotating unit fully qualified for flight. This report discusses rotor and stator design changes incorporated in the CRU V alternator and the effect of these modifications on electrical performance. Design and development of electrical output terminals are also briefly reviewed. (auth)

52567 (NAA-SR-6318) SNAP 2 POWER CONVERSION SYSTEM. DESIGN, DEVELOPMENT AND PERFORMANCE OF CRU IV AND CRU IVM MERCURY VAPOR TURBINES. Topical Report No. 26. Stromquist, A. J. (Thompson Ramo Wooldridge Inc., Cleveland, Ohio. TRW Electromechanical Div.). Mar 1964. Contract AT(11-1)-Gen-8. 81p. (TRW-ER-5831). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

The CRU IV turbine was designed to provide a definite and substantial gain in efficiency over previous SNAP 2 turbines. The CRU IV turbine had a partial-admission first stage and a full-admission second stage with optimum ratios of wheel speed to vapor velocity. The efficiency of the initial CRU IV design was 53%, a 10% gain in efficiency. Fabrication deviations, internal leakage, and pressure losses were corrected in the CRU IVM redesign, and an additional gain of greater than 10% in turbine power and efficiency was realized, as evidenced by testing. CRU IVM turbine efficiency averaged 58% on a total-to-static, blade-to-blade basis, and 57% on a flange-to-flange basis. Although the CRU IVM turbine exceeded specification efficiency, calculations reveal that potential efficiencies of greater than 60% are possible at design point with an improved interstage collector. The techniques used to calculate turbine performance at design point were applied to exact test data conditions and fabricated turbine geometry and produced results that agree within two percent with the test results. (auth)

52568 (NAA-SR-6320(Vol.3)) MERCURY RANKINE PROGRAM (SNAP 2). DEVELOPMENT OF LIQUID-MERCURY-LUBRICATED BEARINGS. VOLUME III. TILTING-PAD BEARING EXPERIMENTAL RESULTS. Decker, Otto (TRW Equipment Labs., Cleveland, Ohio). [nd]. Contract AT(11-1)-Gen-8. 152p. (TRW-ER-6041(Vol.3)). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

On the basis of preliminary laminar analysis with turbulent corrections the three-shoe tilting-pad is selected, sized, and tested for the CRU mercury vapor powered turbogenerator set. The excellent stability characteristics of this bearing type are not influenced by the turbulent flow conditions in the clearance space. A Reynolds number correction factor is established to reflect the increased load capacity over laminar prediction when operating in the region between 1000 < Re < 8000. The tilting-pad bearing meets the major CRU requirements. However, seal erosion, additional seal power loss, possible pivot point wear, and reduced load capacity are the disadvantages associated with the use of this bearing type. (auth)

52569 (NAA-SR-6320(Vol.5)) MERCURY RANKINE PROGRAM (SNAP 2). DEVELOPMENT OF LIQUID-MERCURY-LUBRICATED BEARINGS. VOLUME V. THREE-PAD BEARING EXPERIMENTAL RESULTS. Decker, Otto (TRW Equipment Labs., Cleveland, Ohio). [nd]. Contract AT(11-1)-Gen-8. 107p. (TRW-ER-6041(Vol.5)). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

On the basis of previous development work, the three-pad bearing is selected, sized, and tested for the CRU mercury vapor powered turbogenerator set. Orifice compensation is utilized to provide the necessary stability over the desired operating range. When the excellent stability characteristics are combined with the other satisfactory performance characteristics, such as load capacity, flow requirements, power-loss, and damping, the three-pad, orifice-compensated bearing meets all CRU requirements. The experimental performance of the bearing is reviewed and the reduced data is utilized to establish semi-empirical equations and non-dimensional design curves for load capacity, power loss, and flow at operating Reynolds numbers from 0 < Re < 10,000. Although power loss and flow are increased and decreased respectively, the higher Reynolds number operation has little influence on load capacity which appears to be controlled by the hybrid nature of the bearing. The three-pad, orifice-compensated bearing meets all the major CRU requirements. Surface damage due to cavitation-erosion caused by separation and cyclic loading conditions within the bearing clearance space is the major unresolved problem at this time. (auth)

52570 (NAA-SR-6320(Vol.6)) MERCURY RANKINE PROGRAM (SNAP 2). DEVELOPMENT OF LIQUID-MERCURY-LUBRICATED BEARINGS. VOLUME VI. SPIRAL-GROOVE THRUST BEARING EXPERIMENTAL RESULTS. Decker, Otto (TRW Equipment Labs., Cleveland, Ohio). [nd]. Contract AT(11-1)-Gen-8. 93p. (TRW-ER-6041(Vol.6)). Dep. NTIS.

For Atomics International, Canoga Park, Calif.

On the basis of previous development work, which evaluated the hydrodynamic pocket type Rayleigh step bearing, the spiral-groove thrust bearing is selected, sized, and tested for the CRU mercury vapor powered turbogenerator set. Hydrostatic capacity is achieved by means of an annular orifice restriction to provide the required static load capacity. When combined with the hydrodynamic capacity generated as the speed increases and the other desirable performance characteristics such as flow-pressure requirements and power loss, the double-acting spiral-groove thrust bearing meets all CRU specifications as they exist at this time. The experimental performance of this bearing is presented and compared with predicted performance. The primary dimensional parameter which is varied is total axial clearance. Its influence on load capacity is reviewed. For the selected size and considering supply pressure and flow requirements, the spiral-groove bearing with a total axial clearance of 0.001 inch has the largest minimum film thickness for the specified loads and is therefore selected for application to CRU's. Some agreement is achieved with performance predicted by Whipple's theory. The influence of inertia and turbulence limits the agreement. Power loss in particular is influenced by high Reynolds numbers (R_e at mean diameter greater than >3000). No life limitation in terms of surface damage due to cavitation-erosion is anticipated. (auth)

52571 (NAA-SR-7261) SNAP 8 EXPERIMENTAL REACTOR: A DESCRIPTION. Brinkman, D. S.; Rooney, V. L. (eds.) (Atomics International, Canoga Park, Calif.). 15 Jun 1962. Contract AT-11-1-Gen-8. 88p. Dep. NTIS.

Declassified 26 Oct 1971.

The SNAP 8 Experimental Reactor test facility, the reactor, and the associated process and control systems are described. (H.D.R.)

52572 (NAA-SR-7355) THERMOELECTRIC CONVERSION FOR ADVANCED SNAP SYSTEMS. Morse, C. J. (Atomics International, Canoga Park, Calif.). 15 Dec 1962. Contract AT(11-1)-Gen-8. 71p. Dep. NTIS.

Declassified 26 Oct 1971.

The use of thermoelectric conversion in advanced nuclear space power systems is investigated. A converter design conducive to low weight and high reliability at high power levels is established, and this design is used as a model for estimating weights and radiator areas associated with thermoelectric conversion systems. The range of hot junction temperatures considered is 1200 to 2000°F. The thermoelectric material of primary interest is the germanium-silicon alloy which is used in SNAP 10A. A converter reliability analysis is presented, and a discussion of applications for thermoelectric systems is given. It is concluded that thermoelectric systems offer significant potential for meeting requirements in this decade for highly reliable, long-term auxiliary power. (12 references) (auth)

52573 (NAA-SR-9056) NUCLEAR MERCURY RANKINE POWER PLANT (3 TO 20 kwe) CAPABILITY. Wallerstedt, R. L. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT-11-1-Gen-8. 62p. Dep. NTIS.

Declassified 26 Oct 1971.

The design characteristics and advanced capabilities of a 3- to 20-kwe nuclear Mercury-Rankine powerplant (using a SNAP 2 or 8 reactor) are summarized and discussed. Program objectives and development status are presented. Application problems are considered with attention given to nuclear safety, radiation shielding, interface characteristics, and mechanical and structural data. Reliability criteria are outlined. (auth)

52574 (NAA-SR-9078) SNAP 2 STARTUP ANALYSIS. Gresho, P. M.; Bickel, J. E.; James, L. R.; McDonald, J. S. (eds.)

(Atomics International, Canoga Park, Calif.). 20 Jan 1964. Contract AT-11-1-Gen-8. 166p. Dep. NTIS.
Declassified 5 Nov 1971.

The calculational procedures and results which are used to define the orbital startup methods for the SNAP 2 Unit are summarized. These results also are being used for the design of the startup system components, as well as providing overall system transients which are applicable to the design of the entire SNAP 2 Unit. The analyses presented herein are by no means complete and will be continuously improved as applicable experimental data become available. It is expected that the combination of experimental data and analytical predictions will result in a final flight design and orbital startup method which will be both predictable and reliable. (8 references) (auth)

52575 (NAA-SR-9087) SNAP 2: PERFORMANCE ANALYSIS. Lancet, R. T.; Barbour, P.; Bauer, E. C.; Carruthers, E. C.; Forslund, R. P.; Stultz, J. W. (Atomics International, Canoga Park, Calif.). 15 Feb 1964. Contract AT-11-1-GEN-8. 202p. Dep. NTIS.
Declassified 5 Nov 1971.

The most significant steady-state thermodynamic and fluid dynamic analyses of the SNAP 2 Nuclear 3 to 5 kW power supply are presented. In addition to the general system and design point analysis, the detailed analysis of the thermal and fluid dynamic performance of the Radiator-Condenser and the thermal performance of the instrument compartment are presented. Special potential problem areas, including condenser stability and the effects of reactor hydrogen leakage into the NaK system, are analyzed and discussed in detail. Experimental programs involving single tube condensing mercury pressure drop and stability, braze diffusion effects on the thermal conductivity of copper, and hydraulic loss coefficients of the boiler, pipe welds and bends, and the condensing tube inlet are described and the available results presented. (47 references) (auth)

52576 (NAA-SR-9626) ANALYSIS OF THE RESPONSE OF THE SNAP 8 NUCLEAR SYSTEM DURING STARTUP OF THE POWER CONVERSION SYSTEM. Code, C. J. Jr. (Atomics International, Canoga Park, Calif.). 8 Jun 1964. Contract AT-11-1-Gen-8. 126p. Dep. NTIS.
Declassified 4 Nov 1971.

In order to determine the response of the SNAP 8 nuclear system to power conversion system startup, these systems were simulated on a combination of three general purpose analog computers. Parameter studies were made to determine the permissible range of system parameters and startup conditions. A set of design levels for system startup parameters was selected. Detailed results of the parameter studies are presented. The analog simulation is described and discussed, including the analytical model and analog circuits used. The overall optimization of system parameters results in a well-controlled response of the SNAP 8 system to power conversion system startup. (9 references) (auth)

52577 (NAA-SR-9898) SNAP-10A COMPONENT DEVELOPMENT SUMMARY. VOLUME I. CONTROL COMPONENTS. Kurzeka, W. J. (ed) (Atomics International, Canoga Park, Calif.). 31 Aug 1964. Contract AT-11-1-Gen-8. 170p. Dep. NTIS.
Declassified 5 Nov 1971.

The design, development, and test of components used on the SNAP 10A for control, safety, operational diagnosis, and radiation shielding are summarized in 3 volumes. A summary of efforts for development of a ground test attachment assembly is included. Various materials and process problems pertinent to the program are discussed. (auth)

52578 (NAA-SR-9898(Vol.2)) SNAP-10A COMPONENT DEVELOPMENT SUMMARY. VOLUME 2. SAFETY AND DIAGNOSTIC COMPONENTS. Kurzeka, W. J. (ed.) (Atomics International, Canoga Park, Calif.). 31 Dec 1964. Contract AT-11-1-Gen-8. 112p. Dep. NTIS.
Declassified 5 Nov 1971.

The design, development, and test of components used on the SNAP 10A for control, safety, operational diagnosis, and radiation shielding are summarized in 3 volumes. A summary of efforts for development of a ground test attachment assembly is included. Various materials and process problems pertinent to the program are discussed. (auth)

52579 (NAA-SR-9898(Vol.III)). SNAP-10A COMPONENT DEVELOPMENT SUMMARY. VOLUME III. SHIELD, GROUND TEST ASSEMBLY, AND MATERIALS APPLICATIONS. Kurzeka, W. J. (ed.) (Atomics International, Canoga Park, Calif.). 10 Feb 1965. Contract AT-11-1-Gen-8. 131p. Dep. NTIS.
Declassified 5 Nov 1971.

The design, development, and test of components used on the SNAP 10A for control, safety, operational diagnosis, and radiation shielding are summarized in 3 volumes. A summary of efforts for development of a ground test attachment assembly is included. Various materials and process problems pertinent to the program are discussed. (auth)

52580 (NAA-SR-9900) SNAP 10A REFLECTOR ASSEMBLY DESIGN DESCRIPTION. Jetter, R. I. (Atomics International, Canoga Park, Calif.). 30 Jul 1964. Contract AT(11-1)-Gen-8. 41p. Dep. NTIS.
Declassified 26 Oct 1971.

The configuration and performance of the SNAP 10A reflector assembly are summarized. The performance requirements and design criteria are presented for the various phases of operation included in ground handling and testing, prestartup orbit, and orbital startup and operation. A design description is presented which discusses the function and configuration of the various components which make up the reflector assembly. Stress levels and margins of safety during launch and operation are summarized in the discussion of the structural and mechanical analysis. Reflector and component temperatures during ground testing and orbital operation are discussed. (auth)

52581 (NAA-SR-Memo-6224) SNAPSHOT NUCLEAR FLIGHT SAFETY PROGRAM. (Atomics International; Canoga Park, Calif.). 31 Mar 1961. Contract AT-11-1-GEN-8. 52p. Dep. NTIS.
Declassified 26 Oct 1971.

A nuclear flight safety program for the SNAPSHOT program is presented as a preliminary plan. The program is intended to be compatible with the Atomic Energy Commission's responsibility for nuclear materials used in the SNAPSHOT satellite launch series. Analytical and experimental safety studies are described under three headings: Nuclear Studies, Radiological Safety Studies, and Engineering Design Studies. Program milestones are listed and a description of continuing studies is appended. (auth)

52582 (NAA-SR-Memo-6373) SNAP 8 POWER SYSTEM FOR THE GLOBAL SURVEILLANCE SATELLITE. Stone, R. A. (ed.) (Atomics International, Canoga Park, Calif.). 16 May 1961. Contract AT-11-1-GEN-8. 41p. Dep. NTIS.
Declassified 3 Nov 1971.

It is proposed that the electrical power required for the Global Surveillance Satellite (GSS) be supplied by a modified SNAP 8 nuclear power system. SNAP 8 is a 30 electrical kw system. It will be flight-tested in early 1965. SNAP 8 will offer a light weight, reliable, and rugged system, of proven feasibility, that is compatible with all the GSS requirements. If the GSS power requirement should be increased above its presently estimated 24 kw peak load, the SNAP 8 system offers the advantage of scale-up to 60 kwe with only minor modification to the system. The reactor is cooled by a liquid metal, sodium-potassium eutectic (NaK), which transfers the reactor thermal energy to the mercury working fluid in a compact boiler. The superheated mercury vapor is expanded through a turbine and is passed to a condenser where it transfers its heat of condensation to an organic fluid, Dowtherm A. The Dowtherm is pumped to the radiator, located on the underside of the wings where it radiates the waste cycle heat to space. The entire power system weighs 6750 lb. A weight breakdown is given. 10 references. (auth)

52583 (NAA-SR-Memo-6728) NEUTRON SCATTERING FROM SUPPORTING STRUCTURES OF SNAP 8 SHIELD-REACTOR PACKAGE. Friedman, H. L.; Goetz, C. A. (Atomics International, Canoga Park, Calif.). 6 Sep 1961. Contract AT(11-1)-Gen-8. 10p. Dep. NTIS.
Declassified 5 Nov 1971.

The fast neutron current at the payload due to scattering from structural supports located outside the shielded solid angle defined by the SNAP 8 shadow shield is investigated. The purpose of the study is to provide data with which the vehicle designer may assess the relative radiation penalty incurred by the placement of a given amount of structural material at a particular location. The data are given in terms of integrated fast neutron current (nvt) at the payload per cubic inch of stainless steel. The results indicate that the placement of structural material outside the reactor shield's shadow cone will necessitate the use of a payload shield. (auth)

52584 (NAA-SR-Memo-7286 (Rev.2)) ACCEPTANCE TEST FACILITY SAFEGUARDS REPORT. Soske, P. L.; Ostenso, A. S.; Kamensky, F. J.; Berger, Sheldon (Atomics International, Canoga Park, Calif.). 17 Apr 1963. Contract AT-11-1-GEN-8. 122p. Dep. NTIS.

Declassified 4 Nov 1971.

Safety considerations regarding operation of the Acceptance Test Facility and SNAP-10A units are described. Hazards from normal operation, and malfunctions from minor to maximum credible accidents are considered. Emergency plans and procedures are included. (TSS)

52585 (NAA-SR-Memo-7580) SNAP 2 SYSTEM. Wallerstedt, R. L. (Atomics International, Canoga Park, Calif.). [nd]. Contract AT(11-1)-Gen-8. 51p. Dep. NTIS.

Declassified 2 Nov 1971.

52586 (NAA-SR-Memo-8644) PARASITIC RADIAL MAGNETIC FORCES IN THE CRU-V ALTERNATOR. Terris, David (Atomics International, Canoga Park, Calif.). 26 Jun 1963. Contract AT(11-1)-Gen-8. 23p. Dep. NTIS.

Declassified 4 Nov 1971.

The resultant force on the CRU shaft due to magnetic pull between the rotor and stator under conditions of eccentricity between rotor and stator centers was investigated. The exact conditions of the problem are: (1) alternator operating under no load, or the armature reaction field has negligible effect; (2) the rotor is initially magnetized as a uniformly sinusoidal space distribution; and (3) the eccentricity takes the form of the stator and rotor centers not concentric, otherwise, perfect geometry. The net force on the shaft is in the direction of the point of minimum air gap. This force has a constant component and a superimposed varying component of twice the machine frequency. This varying component, however, is negligibly small and can be ignored. When appropriate allowances are made for leakage flux, almost exact correlation is obtained between measured static forces and the calculated net forces for most values of eccentricity. The estimated leakage reluctance for the path corresponding to maximum flux density is only 3.7 times the uniform gap reluctance at that point emphasizing the fact that rotor leakage flux in the machine is quite significant. (auth)

52587 (NAA-SR-Memo-8705) SNAP-2, FY-1963, CRU-IVM TEST HISTORY. Botts, W. (Atomics International, Canoga Park, Calif.). 9 Jul 1963. Contract AT-11-1-GEN-8. 11p. Dep. NTIS.

Declassified.

During Fiscal Year 1963, Thompson Ramo-Wooldridge, as the major SNAP-2 Power Conversion System Subcontractor, completed the design and fabrication of five CRU-IVM's, and five CRU-IVM (mercury gas turbines) rebuilds. The prime objective of the CRU-IVM effort was developmental in that the program was directed toward obtaining a thorough and detailed technical understanding of the dynamic characteristics, component interactions and the component integration problems within the CRU subassembly. The end objective, second only to the developmental effort, was directed toward the delivery of two units to AI for testing in the S-2-PSM-1 and S-2-PSM-3 systems. Limited CRU-IVM testing will continue through the first quarter of FY 1964. However, the basic objectives stated above were met during FY 1963 as will be shown in the body of this document. (auth)

52588 (NAA-SR-Memo-8768) FAST NEUTRON FLUX THROUGH THE SNAP 10A SHIELD AS COMPUTED BY SEVERAL METHODS. Belcher, J. A.; Farr, W. M. (Atomics International, Canoga Park, Calif.). 23 Jul 1963. Contract AT-11-1-GEN-8. 8p. Dep. NTIS.

Declassified 4 Nov 1971.

Fast neutron fluxes through the SNAP 10A shield as computed by several methods are compared. The methods and the codes using the methods are: (1) neutron transport-DTK, (2) neutron diffusion-AIM-6, (3) Monte Carlo-FMC-N, and (4) neutron removal theory-14-0. These various methods predicted fluxes through the shield which agree reasonably well. On the basis of these analyses and recent Shield Test Facility experiments, a LiH removal cross section of 0.156 cm^{-1} is recommended for use in removal theory code studies of the SNAP 10A shield. Comparable analysis of the SNAP 2 shield indicates that a removal cross section of 0.160 cm^{-1} is valid for use in SNAP 2 shielding studies. (8 references) (auth)

52589 (NAA-SR-Memo-8963) TRANSIENT THERMAL START-UP ANALYSIS FOR CRU V. Mouradian, E. M. (Atomics International, Canoga Park, Calif.). 9 Sept 1963. Contract AT-11-1-GEN-8. 26p. Dep. NTIS.

Declassified 3 Nov 1971.

The transient condition occurring during the start-up period of the CRU-5 (mercury vapor powered turbogenerator set) may cause damage or failure of the unit if the mercury vapor condensation rates or temperature gradients set up are sufficiently severe. In order to estimate the potential severity of these problems, a transient thermal analysis of the CRU-5 was initiated. The CRU-5 was conceptually divided into 98 nodes, including 9 vapor volume nodes, 10 liquid volume nodes, 38 solid nodes, and 41 surface nodes. An energy balance equation was set up for each node to determine its time dependent temperature. In addition, other equations were set up to determine the other mercury vapor properties and the condensation rates as functions of time. These additional equations include mass balance equations, condensation rate expressions, the mercury vapor saturation relation, and vapor flow equations. The vapor flow equations are for nozzle flow, either choked or unchoked, and constant area, or frictional flow. (auth)

52590 (NAA-SR-Memo-8969) FAST NEUTRON ATTENUATION ANALYSIS FOR A SNAP REACTOR SHADOW SHIELD USING THE FLEXIBLE MONTE CARLO CODE, FMC-N. Steichen, C. (Atomics International, Canoga Park, Calif.). 2 Aug 1963. Contract AT(11-1)-Gen-8. 36p. Dep. NTIS.

Declassified 3 Nov 1971.

Calculations were performed to demonstrate the feasibility of using the Flexible Monte Carlo Code, FMC-N, for SNAP shielding analysis. The SNAP 10A reactor-shield configuration, with the original design shield, was used as the calculational model. The results of the calculation were somewhat inconclusive due to the lack of any actual comparison between FMC calculations and experimental data for LiH systems. However, the ability of the code to calculate such things as flux, reflector scattering contribution, leakage effects, spectra, and attenuation between shield bottom and dose plane was demonstrated. Comparisons between the FMC results and previous calculations using ray tracing techniques pointed out areas where the discrepancies in the methods of calculation were sufficiently large to warrant further study. (auth)

52591 (NAA-SR-Memo-9004) SNAP-2 R/C AND PCS COMPONENT TEMPERATURES PRIOR TO INJECTION. Bickel, James E. (Atomics International, Canoga Park, Calif.). 18 Sep 1963. Contract AT-11-1-GEN-8. 114p. Dep. NTIS.

Declassified 3 Nov 1971.

A digital program was written which describes the temperature distribution around the radiator-condenser and the temperature of the secondary system components as a function of time and orbital position. These results are based on the extremes of any actual orbit into which the flight system may be placed (constant sun-constant shade and sun-shade transients orbits). (auth)

52592 (NAA-SR-Memo-9108) MERCURY PUMP DEGRADATION. Abramson, P. B. (Atomics International, Canoga Park, Calif.). 14 Oct 1963. Contract AT-11-1-GEN-8. 18p. Dep. NTIS.

Declassified 4 Nov 1971.

CRU pump performance is described, and an evaluation of how the pump system will (or will not) degrade under long term operation is presented. (auth)

52593 (NAA-SR-Memo-9196) SNAP 10A CORE THERMAL STRESSES DURING STARTUP. Magee, P. M. (Atomics International, Canoga Park, Calif.). 9 Sep 1963. Contract AT(11-1)-Gen-8. 16p. Dep. NTIS.

Declassified 4 Nov 1971.

Thermal stresses within the SNAP 10A reactor core during the anticipated startup transient were analyzed by means of a digital computer code which predicts transient temperature distributions within the core. Inputs for the study were curves of reactor power, flow rate and reactor inlet temperature obtained from the system startup analog analysis. (auth)

52594 (NAA-SR-Memo-9363) SIMULATED ORBITAL STARTUP TEST OF SNAP 10A FSM-1 POWER SYSTEM. Marten, W. F. (Atomics International, Canoga Park, Calif.). 7 Jan 1964. Contract AT-11-1-GEN-8. 37p. Dep. NTIS.

Declassified 3 Nov 1971.

The simulated orbital startup sequence which includes squib firing, control drum insertion and thermal heating to design operating temperature was conducted on the SNAP 10A FSM-1 Power Unit. The expected nuclear reactor thermal cycle was automatically programmed into the electrical core heater. Testing was conducted in a 70°-80°F water cooled vacuum chamber at a pressure of 6 microns. Cryogenic heat sinks surrounding the instrument compartment and thermoelectric pump were provided for local space temperature simulation. An additional heat sink was located beneath the instrument compartment to simulate the Agena environment. A detailed test procedure, with pertinent comments, is presented as are curves showing some of the transients the system underwent. (auth)

52595 (NAA-SR-Memo-9378) THERMO-PHYSICS TECHNICAL NOTE NO. 29. ASYMMETRIC HEAT TRANSFER IN A SNAP 2 FUEL ELEMENT. Fields, S. R. (Atomics International, Canoga Park, Calif.). 7 Jan 1964. Contract AT-11-1-GEN-8. 35p. Dep. NTIS.

Declassified 3 Nov 1971.

A method is presented for the determination of the steady-state asymmetric temperature distributions and heat fluxes, in a SNAP 2 fuel element, due to the influence of the non-circular coolant channel. The results obtained and presented include not only the temperatures and heat fluxes but also convective heat transfer coefficients and an estimate of the reactor overall conductance (UA). The temperatures are presented in both map and graph form. A plot of the heat fluxes reveals a significant variation over the surface of the fuel element. Calculated convective heat transfer coefficients give an average value which is substantially less than those obtained using the Lubarsky—Kaufman and Sletten correlations. A value of 0.8 kW/°F was estimated for the reactor UA. (8 references) (auth)

52596 (NAA-SR-Memo—9514) LONG TERM SNAP 10A REACTOR OPERATION ANALYSIS. Lahs, W. R. (Atomics International, Canoga Park, Calif.). 7 Feb 1964. Contract AT-11-1-GEN-8. 20p. Dep. NTIS.

Declassified 3 Nov 1971.

The long term SNAP 10A reactor operating history was investigated, considering the long term reactivity effects and the feedback to reactor power caused by the heat transfer characteristics of the system. The long term reactor operation code used to solve the problem is described. The code represents the heat transfer and fluid flow in a five node reactor representation coupled with a radiator heat transfer equation and a reactivity relationship. The model is solved at discrete points in time based on the assumption that for the operating histories considered, time dependent terms involving changes in heat capacities can be neglected without significant error. The code calculates reactor temperatures and powers under conditions of relatively slow coolant flow and/or radiator emissivity coating degradations. A 0.1 year time increment is generally used between calculation points; however, a 0.01 year increment is sometimes used to eliminate convergence problems. Assuming the SNAP 10A system with time dependent NaK flow and emissivity coating degradation as input data, the resulting reactor inlet and outlet coolant temperatures and the reactor power are presented as a function of time. (auth)

52597 (NAA-SR-Memo—9589) TRANCORE-10A: A DIGITAL PROGRAM EVALUATING TRANSIENT TEMPERATURES WITHIN THE SNAP 10A REACTOR CORE. Magee, P. M. (Atomics International, Canoga Park, Calif.). 5 Mar 1964. Contract AT-11-1-GEN-8. 53p. Dep. NTIS.

Declassified 2 Nov 1971.

A mathematical model has been developed which describes the reactor kinetics, core heat transfer and thermoelectric pump performance of the SNAP 10A system. From the model, a digital computer code, "TRANCORE-10A", has been prepared which predicts transient temperatures within the reactor core. The code can be used to investigate a wide variety of reactor operational behavior: steady-state, start-up, scram, loss of coolant flow, etc. It has been used extensively to predict startup transients. However, the code cannot be used to evaluate the effects of rapid reactivity changes, i.e., operation near prompt critical. (auth)

52598 (NAA-SR-Memo—9725) PRIMARY LOOP STARTUP CAPABILITIES FOR AN ADVANCED 20 kwe MERCURY RANKINE SYSTEM. James, L. R. (Atomics International, Canoga Park, Calif.). 30 Mar 1964. Contract AT-11-1-GEN-8. 50p. Dep. NTIS.

Declassified 3 Nov 1971.

A study was made, using a modified version of the primary loop code, to determine the feasibility of starting and restarting the advanced 20 KWe mercury Rankine system in much less time than had previously been done with the SNAP 2 system. The study includes a brief description of a 20 KWe system and discusses the transients obtained for initial preheat, mercury injection, reactor shutdown, and system restart. The analysis demonstrates that a safe startup or restart may be completed in approximately 30 minutes. A discussion is made of a possible problem in the injection phase of startup, if simultaneous injection of all mercury systems is attempted, and a delayed mercury injection method is recommended as a possible alternate. The analysis also concludes that flux control of the reactor is not required, and that the reactor startup procedures and control developed for the SNAP 2 system may be utilized for the 20 KWe system without any major modifications. (auth)

52599 (NAA-SR-Memo—9726) STARTUP AND SHUTDOWN TRANSIENTS FOR THE SNAP-2 R/C AND PCS COMPONENTS. Bickel, J. E. (Atomics International, Canoga Park, Calif.). 26 Mar 1964. Contract AT-11-1-GEN-8. 44p. Dep. NTIS.

Declassified 3 Nov 1971.

An orbital heating code is used to determine temperature transients which are discussed. An effective primary system emissivity of 0.15 internal to the radiator-condenser (R/C) was found to be sufficient to insure that the power conversion system (PCS) components and the R/C are above the freezing point of mercury at injection. This value of emissivity results in a steady-state heat loss of 2.5 kW. If the SNAP-2 system is shut down while in orbit (constant sun-constant shade orbit), the mean R/C temperature after 120 minutes was 35°F while the coldest R/C node decays to 0°F in 100 minutes. An additional study was the effect of preheating the combined rotating unit (CRU) and injection tank to 700 and 500°F, respectively, prior to launch. The resulting temperature of the CRU shaft was 225°F and the injection tank 140°F at mercury injection. (auth)

52600 (NAA-SR-Memo—10161) FINAL QUALIFICATION TEST REPORT, SNAP-10A REFLECTOR BEARINGS. PART NUMBER 10FSM1-11039. Powell, H. L. (Atomics International, Canoga Park, Calif.). 30 Jun 1964. Contract AT-11-1-GEN-8. 54p. Dep. NTIS.

Declassified 4 Nov 1971.

SNAP 10A reflector bearings were subjected to the following tests: thermal cycle, shock, vibration and acceleration, and endurance. The reflector bearings were tested to Specification NA 0408-008 and have met its requirements with approved deviations. (auth)

52601 (NAA-SR-Memo—10240) SNAP 10A STARTUP CONTROLLER FINAL QUALIFICATION TEST REPORT. Checketts, D. A.; Nummelin, J. L. (Atomics International, Canoga Park, Calif.). 20 Jul 1964. Contract AT(11-1)-Gen-8. 21p. Dep. NTIS.

Declassified 4 Nov 1971.

Three SNAP 10A startup controllers were tested through thermal cycle, shock, vibration, acceleration, radiation, radio frequency interference and endurance. The controllers completed thermal cycle, shock, vibration, acceleration, radiation and endurance tests with no failures. The controller did not meet all the requirements of the radio frequency interference test for conducted interference at 150 kc and radiated interference at 150—200 kc and 100 mc. These deviations were accepted since compatibility problems in the system could be corrected by appropriate shielding, wire routing, or filtering. A noise susceptibility problem discovered during system testing was corrected by the addition of a 6.8 microfarad capacitor external to the controller. No other radio interference problems were encountered during system tests. (auth)

52602 (NAA-SR-Memo—10278) SNAP 10A FSM-4 TEST STATUS. Brunings, J.; Vaughn, W. (Atomics International, Canoga Park, Calif.). 15 Sep 1964. Contract AT-11-1-GEN-8. 41p. Dep. NTIS.

Declassified 4 Nov 1971.

The SNAP-10A FSM-4 system test program, schedule, and test objectives are described. An evaluation of the system test reliability is summarized based on component test data available as of June 1, 1964. (auth)

52603 (NAA-SR-Memo—10687) STABILITY ANALYSIS OF A SNAP CORE EQUIPPED WITH A MECHANICAL TEMPERATURE COEFFICIENT AUGMENTOR. Johnson, R. L.; Arnold, D. J.; Halseth, M. W. (Atomics International, Canoga Park, Calif.). 12 Nov 1964. Contract AT-11-1-GEN-8. 22p. Dep. NTIS.

Declassified 3 Nov 1971.

A transfer function is developed for a somewhat simplified SNAP system equipped with a proposed device for increasing the temperature coefficient. The system stability is then examined by constructing Nyquist and Bode Plots by means of the digital program TRAFFIC, for several different power levels and coolant flow rates. Indications are that the system is quite stable for a wide range of these parameters. The response of the system to a sun—shade orbit is also calculated. Oscillations in the reactor power are less than 0.5% of the steady-state value. (5 references) (auth)

52604 (NAA-SR-Memo—10723) HIGH POWER CRU SCALING ANALYSIS AND PRECONCEPTUAL DESIGNS. (Atomics International, Canoga Park, Calif.). Jul 1964. Contract AT-11-1-GEN-8. 61p. Dep. NTIS.

Declassified 3 Nov 1971.

The objective of the study was to define sufficient criteria to confidently conduct a systems evaluation. Several alternator and turbine concepts were studied on a preliminary basis. After screening competing concepts, four turboalternator designs, both 15 kW(e) and 25 kW(e) CRU's were analyzed at 12,000 and 24,000 rpm. From these, a 24,000 rpm, 15 kW(e) CRU and a 12,000 rpm, 25 kW(e) CRU were analyzed in more detail to provide systems analysis criteria. (auth)

52605 (NAA-SR-Memo-11119) STRESS ANALYSIS OF S8DS CORE VESSEL ASSEMBLY. Kubota, K. (Atomics International, Canoga Park, Calif.). 2 Mar 1965. Contract AT-11-1-GEN-8. 107p. Dep. NTIS.

Declassified 2 Nov 1971.

An analysis was made to determine the adequacy of the S8DS reactor vessel assembly to retain its integrity under anticipated loadings and environmental conditions. For the operational phase, the results of the analysis confirmed the integrity of the structure in all cases except one. The severe temperature gradient around the outlet nozzle region results in a high stress momentarily and some yielding will occur. However, due to yielding and relaxation, the stress will remain at this level only for a short period, and will not be detrimental to normal operation of the core vessel. For the launch environment, the maximum "g" loadings that the various parts of the core vessel assembly can withstand were calculated. A summary of the significant stress analysis is presented. (19 references) (auth)

52606 (NAA-SR-Memo-11225) POST TEST EXAMINATION OF P-ELEMENTS IN T/E PUMPS DEV-4 AND DEV-5. Reed, E. L. (Atomics International, Canoga Park, Calif.). 5 Apr 1965. Contract AT(11-1)-Gen-8. 9p. Dep. NTIS.

Declassified 2 Nov 1971.

Photomicrographs of the cold side of the P-elements from T/E Pumps DEV-4 and DEV-5 are exhibited and discussed. The results were not conclusive; but there appeared to be significantly less contamination in the tin-free lead telluride materials from these pumps, than has been observed in the lead tin telluride type of P-elements after comparable periods of performance testing. (auth)

52607 (NUS-136) ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS. Quarterly Progress Report. (Nuclear Utility Services, Inc., Washington, D. C.). Apr 1963. 43p. Dep. NTIS.

For Space Nuclear Propulsion Office (AEC/NASA), Washington, D. C.

Declassified 22 Oct 1971.

Evaluation of radiation hazards involved with rocket reactor flight accidents is presented. Effects of meteorological conditions on radiation distribution from rocket reactor accidents are calculated. Radiation doses to man from rocket reactor accidents are analyzed. 14 references. (D.C.C.)

52608 (PREXDC-916) SECOND REVIEW DRAFT AND ADVANCED ENGINEERING CONTRIBUTION TO NUCLEAR ROCKET PROPOSAL. SECTION 1. PRELIMINARY DESIGN. Towle, H. C. (General Electric Co., Cincinnati, Ohio. Aircraft Nuclear Propulsion Dept.). 14 Mar 1961. Contract AT(11-1)-171. 52p. Dep. NTIS.

Declassified 19 Oct 1971.

Design proposals for the Nuclear Engine for Rocket Vehicle Application (NERVA) are presented. The major components described are KIWI-B1 reactor with pressure shell, shield assembly, propellant feed system, thrust nozzle, thrust structure, and control system. (H.D.R.)

52609 (RN-S-309) NRX/EST DATA ANALYSIS. Altseimer, J. W.; Benenson, H.; Conn, K. R.; Fong, L. Y.; Kasahara, M.; Misra, B.; Sebek, E. J.; Slonim, N. H.; Wilgus, C. A.; Williams, R. J. (Aerojet-General Corp., Sacramento, Calif.). Jul 1966. 329p. Dep. NTIS.

Declassified 20 Oct 1971.

The NRX/EST test series was the first complete nuclear rocket engine system with major components connected in the flight functional relationship. The most significant accomplishments were: verified feasibility of the hot bleed cycle nuclear engine system including the ability to startup (bootstrap) smoothly and satisfactorily in a large number of different startup modes; demonstrated engine operating region and the smoothness with which the engine could perform at both design and off-design conditions; demonstrated the ability of the engine as a whole, consisting of the reactor and the various non-nuclear components to operate for extended durations; and the accumulation of a large amount of systems, controls, and component data to permit a firmer basis of understanding the verification of the analytical tools to support the design of the X-engine and the larger NERVA engine. The overall operation of the NRX/EST breadboard engine and various non-nuclear aspects and components is described. (13 references) (auth)

52610 (RN-S-309(Suppl.)(Bk.1)) NRX/EST DATA ANALYSIS REPORT. Glaeser, D. B.; Henschel, A. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif.). Nov 1966. 162p. Dep. NTIS.

Declassified 20 Oct 1971.

Multiple plots of data monitored during the Nerva Engine Systems Test series are presented. (H.D.R.)

52611 (RN-S-309(Suppl.)(Bk.2)) NRX/EST DATA ANALYSIS REPORT. Glaeser, D. B.; Henschel, A. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif.). Nov 1966. 507p. Dep. NTIS.

Declassified 20 Oct 1971.

Multiple plots of data monitored during the Nerva Engine Systems Test series are presented. (H.D.R.)

52612 TO MARS IN 30 DAYS BY GAS-CORE NUCLEAR ROCKET. Ragsdale, Robert G. (Lewis Research Center, Cleveland). Astronaut. Aeronaut.; 10: No. 1, 65-71(Jan 1972).

The research program on a concept embracing the capabilities required for a 60-day Mars mission, the gas-core nuclear rocket engine, is reviewed. The gas-core engine uses fissioning uranium plasma to heat hydrogen and then expands it through a nozzle to convert the thermal energy to thrust. Gaseous fuel criticality is discussed. (M.C.G.)

52613 WHAT CAN NUCLEAR ENERGY DO FOR SOCIETY? Rom, Frank E. (Lewis Research Center, Cleveland). Astronaut. Aeronaut.; 10: No. 1, 56-61(Jan 1972).

Applications of nuclear energy for commercial electric power, marine propulsion, air-cushion vehicle propulsion, and aircraft propulsion are considered. (M.C.G.)

Process Heat and Desalination Reactors

52614 (JAERI-Memo-4034) REFERENCE DESIGN OF THE JAPAN EXPERIMENTAL HIGH TEMPERATURE GAS-COOLED REACTOR. Nozawa, Masao (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

A preliminary design study as a reference design on the graphite-moderated helium-cooled, and low-enriched uranium carbide-fueled reactor with a 50 MW(t) power and an outlet temperature of 1000°C was undertaken. To make it possible to purge the fission product gases from the fuel separately from main coolant helium, a rod type of core fuel design was adopted. The reactor vessel is of low alloy steel. Coolant helium gas pressure was chosen as 40 kg/cm. There are 3 main coolant circuits; one for iron production, one for chemical processing, and one for electricity production. (auth)

52615 GASGEKUEHLTE HOCHTEMPERATURREAKTOREN. (Gas-Cooled High-Temperature Reactor). Bedenig, Dieter. Thiemig-Taschenbuecher, Band 44. Munich; Verlag Karl Thiemig (1972). 254p. DM 19,80.

Gas-cooled high-temperature reactors stand at the threshold of economic utilization and a comprehensive survey of this reactor type is presented. Fuels and fuel elements as well as physics of high-temperature reactors are discussed. The primary circuit, support installations, methods for insertion of fuel elements, and reactor safety are described. Future trends in the development of this reactor type, especially with respect to immediate utilization of the heat produced in the chemical and metallurgical industry. (H.B.G.)

52616 CHOICE BETWEEN NUCLEAR AND CONVENTIONAL HEAT PLANTS. Bortlik, Jiri (Vyzkumny Ustav Energeticky, Prague). Energetika; 22: No. 4, 154-6(1972). (In Czech).

Conditions under which it is more convenient to employ nuclear rather than conventional heat plants as a source of heat for district heating are discussed. The power limit between conventional and nuclear heat plants was calculated and the principles necessary for evaluating the choice from engineering and economic points of view are listed. The derived results were analyzed and the effect of the individual input data is described. (auth)

Research and Test Reactors

Refer also to abstracts 50435, 50641, 51020, 51959, 52319, 52355, 52425, and 52550.

52617 (AD–736177) REACTOR DOSIMETRY WITH PAIRED MINIATURE IONIZATION CHAMBERS. Shosa, D. W. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Dec 1971. 16p. (AFRRI-TN–71-7). NTIS.

Paired ionization chambers with nominal volumes of 0.05 cc are in use at the Armed Forces Radiobiology Research Institute to measure neutron and gamma components of depth doses in steady-state and pulsed TRIGA fields. Cavity chamber theory is employed to obtain quantitative estimates of neutron and gamma dose sensitivities of a chamber with a tissue-equivalent plastic wall filled with a tissue-equivalent gas and magnesium chamber filled with CO_2. The uncertainties in these estimates have been propagated through the paired chamber equations and result in the reported uncertainties in measured dose components in a field where the neutron to gamma dose ratio varies from 0.1 to 15. (auth) (USGRDR)

52618 (AEEW–M–997) SPECTRUM MEASUREMENTS IN FAST REACTOR ASSEMBLIES. Broomfield, A. M.; Paterson, W. J.; Sanders, J. E. (Atomic Energy Establishment, Winfrith (England)). Oct 1970. 46p. Dep. NTIS (U. S. Sales Only).

Techniques used for the measurement of neutron energy spectra in the fast reactor assemblies VERA at Aldermaston and ZEBRA at Winfrith are reviewed including time-of-flight, proton-recoil, lithium-6 and double-scintillator spectrometers. Results of some recent measurements are presented and compared with theoretical prediction. 25 references. (auth)

52619 (ANCR–1076) PBF SYSTEM OPERATION TEST: OPERATIONS PHASE PLAN. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jul 1972. Contract AT(10-1)-1375. 16p. Dep. NTIS.

The purpose of SO (Systems Operation) testing is to verify that any particular system will function in accordance with operational performance requirements and design. The SO Test Plan describes the general objectives of the tests, interdependency and sequencing of the SO tests with the Construction Component (CC) tests, and the test management procedures including the interfacing between various companies involved. (auth)

52620 (ANL–7927) ACTIVATION-RATE MEASUREMENTS IN THE ZPR-3 MOCKUP CRITICAL EXPERIMENTS. PART III. MEASUREMENTS OF FOIL-ACTIVATION RATES IN ASSEMBLIES 62 AND 63 OF ZPR-3 MOCKUPS OF EBR-II WITH A STAINLESS STEEL REFLECTOR. Dudey, N. D.; Popek, R. J.; Heinrich, R. R. (Argonne National Lab., Ill.). Jun 1972. Contract W-31-109-Eng-38. 48p. Dep. NTIS.

A complete description of the activation-rate measurements conducted in Assemblies 62 and 63 of ZPR-3 is presented. Both assemblies simulated EBR-II with a stainless steel reflector. They differed in that Assembly 62 represented a homogeneous core with a composition similar to EBR-II, whereas Assembly 63 was composed of a heterogeneous series of drawer loadings and represented a more "typical" EBR-II core loading. In Assembly 62, foil-activation-rate measurements were made in three principal locations: near the core center, near the core-blanket interface, and within the radial reflector. In Assembly 63, foil-activation-rate measurements of only ^{235}U and ^{238}U were made at 15 different drawer locations. The Assembly 63 experiment provided fission-rate traverses, as well as an examination of the effects that various types of drawer loadings had upon the fission rates. For Assembly 62, the reaction-rate data are presented, intercompared, and also compared with the results from another activation-rate experiment. Assembly 63 fission rates determined by foil activation are compared with results obtained by fission-counter traverses. (auth)

52621 (BNWL–1102(DR.1)) U. K. COMMERCIAL DATA EMPLOYED IN FFTF FUEL PIN AND SUBASSEMBLY CONCEPTUAL DESIGN. Stevens, E. G.; Cohn, P. D.; Jackson, R. J.; Kolesar, D. C.; Mohr, C. L.; Padilla, A.; Wheeler, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 29 May 1969. 31p. Dep. NTIS.

Data on fast reactor fuel element and subassembly design obtained from the United Kingdom are presented. Included are irradiation effects on fuel and cladding swelling and stress effects on clad and plenum sizing. 11 references. (H.D.R.)

52622 (CEA-N–1524) RAPSODIE-FORTISSIMO START-UP POWER MEASUREMENTS. Gourdon, Jean; Besoux, Michel; Chenal, Jean-Claude (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1972. 54p. (In French). Dep. NTIS (U. S. Sales Only).

The problem of power determination in the Rapsodie–Fortissimo fast reactor was studied. The different results and methods used during the reactor start-up are reviewed. Thermal balances, determination of the power in sub-assemblies, and the linear power in the core center were studied using thermal and neutron methods. Power control and special measurements for control system testing were also investigated. (France)

52623 (CISE-R–262) STUDY OF THE STATUS OF PRESSURE AND INFORMATION OF A FUEL ELEMENT OF THE TYPE CIRENE. Cravarolo, L.; Mazzotti, G.; Saccone, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1967. 167p. (In Italian). Dep. NTIS (U. S. Sales Only).

Calculation methods and design problems of a single CIRENE fuel element are summarized. The problem of temperature distribution across UO_2 pellets, with reference to the effects due to fuel enrichment, was considered. Axial and radial thermal expansion of UO_2 pellets were evaluated according to the well-known Canadian model. Equations to calculate internal pressure from fission gas release are presented. The fission gas influence on the behavior of the fuel element was investigated for creep and stress relaxation in the cladding. The problem of accommodating internal fission gas and moderating axial thermal expansion of UO_2 (dish design in UO_2 pellets) was considered. An analytical study was performed to calculate strain and stress distributions, both in elastic and plastic fields, produced by fuel cladding differential thermal expansion. Some theoretical considerations are given to the problem of axial ratchetting in the CIRENE fuel element. (33 references) (auth)

52624 (DOCKET-50231–123) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Answers to Questions in Connection With Termination of License. (Southwest Atomic Energy Associates). 3 Aug 1972. 25p. Dep. NTIS.

Requested additional data are presented on the costs for the Southwest Experimental Fast Oxide Reactor. (D.C.C.)

52625 (GEAP–13787) SEFOR FOLLOW-ON PROGRAM PHASE A. Final Report, June 15, 1971–December 31, 1971. Arterburn, J. O. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Mar 1972. Contract AT(04-3)-189. 376p. Dep. NTIS.

IN-PILE LOOPS—design characteristics of test fuel pin, for liquid sodium cooled test reactor
PRESSURE VESSELS—heat transfer through liquid sodium cooled test reactor
—stress distribution in main flange of liquid sodium cooled test reactor
REACTOR CONTROL ELEMENTS—design characteristics of liquid sodium cooled test reactor
REACTOR FUEL ELEMENTS—design parameters for liquid sodium cooled vented rods
—design characteristics of liquid sodium cooled fast test reactor
—performance limits for liquid sodium cooled Type 316 stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2) rods
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR—piping systems for, layout of liquid sodium
—pressure vessel for, stress distribution in main flange of
—pressure vessel for, heat transfer through
—fuel element assemblies for, design characteristics of
—control elements for, design characteristics of
—experimental facilities for, design characteristics of test fuel pin in-pile loop
—quality assurance program for
—fuel elements for, performance limits for Type 316 stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2) rods
—physics measurements for, (E)
—fuel elements for, design parameters for vented rods
—instrumentation for, design characteristics of monitoring
—cooling system for, performance requirements for cold traps and vapor traps for
—cooling system for, component stress analysis for
TRAPS—performance requirements for cold and vapor, for liquid sodium cooled reactors (D.C.C.)

52626 (GULF-GA-A–12123) PLANNED THERMAL IRRADIATION OF MANIFOLDED-VENTED (U, Pu)O_2-FUELED ROD IN ORR CAPSULE GB-10. Lindgren, J. R.; Campana, R. J.; Baldwin, N. L.; Langer, S.; Longest, A. W. (Gulf General Atomic Co., San Diego, Calif.). 31 Jul 1972. Contract AT(04-3)-167. 95p. Dep. NTIS.

The experimental design and planned test procedures for the thermal irradiation of vented, sweep-gas capsule GB-10 in the Oak Ridge Research Reactor (ORR) are described. The purpose of the test is to obtain information on the release, transport, and trapping of volatile fission products and to determine the behavior of a simulated leaking fuel rod. Test conditions include operation of the (U,Pu)O_2-fueled rod (GA-21) to achieve a burnup >75,000 MWd/Te (23 × 10^{20} fissions/cm^3) at linear heat-generation rates of 12 kW/ft and ~15 kW/ft, a maximum cladding outer surface temperature of 700°C, and operation of the fission-product trap with its outer surface at 200 to 400°C. Fission products effusing from the fuel, blanket, and trap of the fuel rod during steady-state operation and during breathing will be monitored to determine the performance of the fuel and the fission-product trap. Pressure cycling and thermal cycling of varying degrees of severity will be performed. (auth)

52627 (HEDL-TME-71-57) ANALYSIS OF FTR PHASE B CRITICAL EXPERIMENTS. PART-3. DOPPLER EFFECT IN ZPR-3, ASSEMBLY 51. Young, W. R.; Bennett, R. A. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 48p. Dep. NTIS.

Twelve Doppler experiments were performed using a single UO_2 Doppler sample on the core midplane at the core axis, r = 0, midway out in the core, r = 22.2 cm, and near the core boundary, r = 33.3 cm. At each location, the Doppler reactivity effect of the sample, due to temperature changes from 300°K to 500°K, 300°K to 800°K, and 300°K to 1100°K, was determined using a nickel buffer sleeve on the Doppler sample. For the same temperature increments, but with a stainless steel buffer, the experiments were repeated at r = 0. Calculation to experiment ratios of the Doppler effects, c/e values, for a 300°K to 1100°K temperature change ranged from 1.13 at the core center to 0.836 at the core edge with a nickel buffer and are as large as 1.27 at the core center with a stainless steel buffer. Statistical analyses of the experimental data and corresponding calculated results are presented. 16 references. (auth)

52628 (HEDL-TME-72-66) CLIRA DECAY HEAT REMOVAL TEST. Winegardner, W. Kevin; Romsos, W. N. (Hanford Engineering Development Lab., Richland, Wash.). May 1972. Contract AT(45-1)-2170. 66p. Dep. NTIS.

An electrically heated test facility was designed and fabricated for use in an ex-reactor investigation of heat transport during the handling of a solid wall flow tube type Closed Loop In-Reactor Assembly (CLIRA) while in the shielded, air-cooled Combined Loop Ex-Vessel Machine (CLEM). The heat generation zone was limited to the bottom three feet of an approximately 12-foot long vertical column of sodium contained in a simulated 3¾ in. OD CLIRA integral pot. Heat was transmitted radially from the sodium column (pot), across a "stagnant" argon gas gap, to the inner surface of a simulated CLEM cold wall. Finally, heat could be removed by axial forced air flow past the finned outer surface of the cold wall. A heat generation rate of six kW was attained in tests without flow tube overflow, with a maximum air-cooling rate of 1020 CFM, and a heating element cladding temperature limit of 1000°F. Eight kW were attained in similar tests, except that the sodium was allowed to overflow the top of the flow tube and recirculate by natural convection. Tests with the sodium level below the top of the flow tube and heat generation rates above 1 to 2 kW resulted in an essentially linear, axial temperature gradient of about 5°F per inch in the region above the heated length. The formation of this gradient was attributed primarily to convective buoyancy-driven instabilities. In tests with heat generation rates of 1 to 2 kW, it was necessary to drastically reduce the air cooling rate to prevent freezing at the top of the sodium column. (auth)

52629 (HEDL-TME-72-93) GAS TAG BURNUP ANALYSIS FOR FUEL FAILURE LOCATION AND DETECTION IN THE FTR. Boulette, E. T.; Schenter, R. E.; Schmittroth, F. (Hanford Engineering Development Lab., Richland, Wash.). Jul 1972. Contract AT(45-1)-2170. 43p. Dep. NTIS.

Calculations were made to determine time-dependent ratio changes of noble gas isotopes being considered for use as tags for fuel failure detection and location in the Fast Test Reactor (FTR). The ratio changes occur due to neutron capture by the individual tag gas isotopes. Results are presented for the FTR as a function of exposure time. Analyses extending over the average lifetime of a fuel assembly are given for seven isotopes of interest: ^{78}Kr, ^{80}Kr, ^{82}Kr, ^{124}Xe, ^{126}Xe, ^{128}Xe, and ^{129}Xe. Uncertainties in the calculations, as propagated from uncertainties in the capture cross sections and neutron flux distributions, are also included. (auth)

52630 (JAERI-M-4658) PROMPT NEUTRON DECAY CONSTANTS AT DELAYED CRITICAL OF FCA FAST ASSEMBLIES OF URANIUM FUEL. Hiraoka, Toru; Nakano, Masafumi; Mukaiyama, Takehiko; Nakamura, Tomoo (Japan Atomic Energy Research Inst., Tokyo). Dec 1971. 8p. NTIS (U. S. Sales Only).

The prompt neutron decay constants at delayed critical of seven uranium fuel fast assemblies of FCA were directly measured by the pulsed neutron method. The discrepancy between the experiment and the calculation has been reduced a great deal by use of JAERI-FAST 25 group set for the calculations. One of the causes of the discrepancy is concluded to be the difference between the calculated spectrum and the actual spectrum in systems. (auth)

52631 (JAERI-M-4720) DESIGN OF NEUTRON CHOPPER TRANSMITTING NEUTRONS IN LARGE ENERGY RANGE. Kaneko, Yoshihiko; Kurokawa, Ryosuke; Inoue, Toshiaki; Watanabe, Tuneshi (Japan Atomic Energy Research Inst., Tokyo). Feb 1972. 16p. (In Japanese). NTIS (U. S. Sales Only).

A neutron chopper has been designed and constructed for use in thermal reactor physics experiments. Features of the neutron chopper are the following: 1. Stainless steel containing 1 wt % ^{10}B(SUS 304) is used in the periphery of the single slit. In the other parts of the rotor, stainless steel without it is used. The rotor is 30 cm in diameter and 4 cm thick. 2. The inlet window of the slit is 4 mm wide and 20 mm high; the width is enlarged toward the exit window in order to transmit neutrons in an energy range as wide as possible. 3. The rotor is suspended vertically with a shaft of diameter 40 mm. The rotation of the rotor can be varied from 700 to 4600 r.p.m. with a frequency reduction machine connected to the power source of a 3-phase induction motor. 4. The rotor is in a neutron-shielding box of 1-cm thick B_4C walls to reduce background neutrons. It is found by calculation that neutrons in a large energy range (from 10 eV down to 0.0001 eV) can be transmitted with good time resolution. (auth) (Japan)

52632 (JAERI-Memo-3957) NSRR (NUCLEAR SAFETY RESEARCH REACTOR). Study Report of Nuclear Safety Experimental Program: Number 3. (Japan Atomic Energy Research Inst., Tokyo). 23 Mar 1970. 81p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The activities of the Nuclear Safety Research Reactor working group are reported for the period from July 1967 to March 1970. Included are a summary of the third period activities, an analysis of the NSRR capability, and preanalysis calculations for the NSRR experimental program. (auth)

52633 (JAERI-Memo-4031) SUMMARY OF RESEARCH ACTIVITIES FOR REACTIVITY ACCIDENT AND NUCLEAR SAFETY RESEARCH REACTOR PROGRAM. Yamasaki, Fumio (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

Results discussed at the Nuclear Safety Research Reactor (NSRR) Advisory Committee organized to examine NSRR and it's research program are discussed. The NSRR program is an experimental research program on reactivity accidents in nuclear plants. Technical knowledge of reactivity accidents and research activities status are discussed. Technical cooperation with foreign countries is considered. The NSRR experimental program, its pulse character, safety evaluation of the NSRR are discussed. (M.C.G.)

52634 (ORNL-TM-3151) STUDY OF FISSION PRODUCTS IN THE MOLTEN-SALT REACTOR EXPERIMENT BY GAMMA SPECTROMETRY. Houtzeel, A.; Dyer, F. F. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 213p. Dep. NTIS.

A technique was developed to locate and measure fission product depositions on surfaces exposed to the salt and in the off-gas system of the MSRE by the intensity and energy spectrum of the emitted gamma rays. A gamma-ray spectrometer was developed, consisting of a Ge(Li) detector, a 4096-channel analyzer, and a lead collimator to permit examination of small areas. This device was usually positioned with the MSRE portable maintenance shield over the different reactor system components, with precise alignment and location achieved by a laser beam and surveyor's transits. Measurements were made not only with the reactor system shut down and drained but also with the fuel circulating and the reactor at several power levels. Altogether some 1000 spectra were taken, 25% of which were recorded with the reactor at some power level (a few watts to full reactor power). Another 400 spectra were taken to calibrate the equipment. Computerized data handling permitted this mass of data to be analyzed qualitatively and quantitatively. Most of the effort was focused on the off-gas system and the primary heat exchanger, the latter because it contains 40% of the metal surfaces exposed to the salt. The off-gas system contained not only fission products with gaseous precursors but also metallic elements with their decay products [such as Nb, Mo, Ru, Sb, Te(I)]. The MSRE heat exchanger contained mostly depositions of the same metallic elements. It was observed that fission gases form a major source of activity in the heat exchanger when the reactor is shut down and the fuel is drained immediately (emergency drain). (auth)

52635 (ORNL-TM-3883) EVALUATION OF THE ^{252}Cf METHOD FOR SOURCE LEVEL FLUX MONITORING IN THE FTR. Buhl, A. R.; Childs, R. L. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 50p. Dep. NTIS.

In the present FTR design, the Low Level Flux Monitor (LLFM) is to be installed in the radial shield on the core axial midplane. Because of mechanical and shielding complexities, an alternate source level monitoring system was evaluated to determine the feasibility of eliminating the LLFM from the FTR design. The alternate system comprises a large ^{252}Cf source in the core and the existing ex-vessel flux monitoring system which is located in the reactor wall cavity. The results of this study are: with no stored fuel, less than 1 mg of ^{252}Cf is required for the alternate system; depending on the level of subcriticality, the addition of stored fuel increases the requirement to 20 to 53 mg of ^{252}Cf for 16 stored fuel assemblies per array and to more than 100 mg for 22 stored fuel assemblies per array; the graphite block is detrimental to the signal-to-noise response of the ex-vessel detectors and increases the required inventory of ^{252}Cf; and removal of the graphite block reduces the required inventory of ^{252}Cf by almost a factor of 2. (auth)

52636 (ORNL-TM-3928) FAST REACTOR SHIELDING MONTHLY PROGRESS REPORT FOR JUNE 1972. 189a No. 10028, Activity No. 40 01 61. Mynatt, F. R.; Gritzner, M. L.; Maerker, R. E.; McGregor, B. J. (Oak Ridge National Lab., Tenn.). Aug 1972. Contract W-7405-eng-26. 63p. Dep. NTIS.

FAST TEST REACTOR—shielding for, neutron and γ flux in cavity, vessel support, and head compartment, (T)
—pipeway cavity in, neutron streaming in, (E/T)
TOWER SHIELDING FACILITY—pipe chase mockup in, neutron streaming in, (E/T)
—duct mockup in, Bonner ball neutron flux traverses in, (E) (H.D.R.)

52637 (PTR-229(Add.)) HANDLING OF GEANP-ETR EXPERIMENTS WITH FISSION PRODUCT EVOLUTION. ADDENDUM TO PTR-229. SPECIAL HAZARD CONSIDERATIONS FOR THE ENGINEERING TEST REACTOR. Jones, L. H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). 2 May 1958. Contract AT(10-1)-205. 26p. Dep. NTIS.
Declassified 22 Oct 1971.

A general description of the experimental equipment is given. Calculations show that normally the hazard from failure of an air-cooled experiment is not dangerous. However, during fumigation conditions, a failure would be very serious. Therefore, recommendations are to operate with limited fission product evolution during most weather conditions, but during fumigation conditions the experiment must be shut down. (11 references) (auth)

52638 (WASH-1517(Dr.)) LOSS-OF-FLUID TEST FACILITY AT THE NATIONAL REACTOR TESTING STATION. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Jun 1972. 87p. Dep. NTIS.

The Draft Environmental Statement was prepared in compliance with the National Environmental Policy Act for the U. S. Atomic Energy Commission's (AEC) proposed operation of the Loss-of-Fluid Test (LOFT) facility. The following alternatives were considered and rejected in the initial planning for the LOFT program and in the design of the facility. (1) Accomplish the LOFT program objectives at a location other than the NRTS. (2) Conduct the LOFT program at an alternate facility at the NRTS. (3) Eliminate the LOFT program objectives from the AEC's reactor safety program. (4) Provide alternative treatments for liquid and airborne effluents. The environmental and technical benefits expected to be gained from the operation of this facility and completion of the experimental program and the environmental and monetary costs associated with completion of the LOFT experimental program, as well as the foregoing range of alternatives and their environmental impacts, were evaluated, and it was concluded that the AEC should complete the facility as presently designed and conduct the proposed experimental program. (auth)

52639 WATER STRAINER FOR HFIR (20 May 1971) (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-2258).
10 drawings.

A rugged strainer, which is designed as two segments of a cylinder, is fabricated of a ¼ in. stainless-steel perforated plate, welded to give a tapered quasi-conical shell with lenticular-cross section with the major axis parallel to the flow direction. The perforated plate is lined with heavy mesh screen. To average out the flow velocity and reduce the pressure drop, the screen is formed from sections of a plate rolled into a cylinder and sliced off at a 10° angle. The screen is held firmly against the wall of the supporting-perforated plate by the water pressure across the screen and the rivets attaching it to the plate at regular intervals. The strainer is the final line of defense for protecting the HFIR core against the entrance of foreign materials. The construction permits adequate screen support with flow areas proportioned to minimize pressure drop. The strainer, in the relatively clean HFIR system, should last for the life of the reactor. (For details see TID-4100 Suppl 72) (see also 26: 27568) (F.S.)

52640 ESTIMATE OF THE NEUTRON RADIATION DOSE AT THE ZfK ROSSENDORF RESEARCH REACTOR (RFR). Adler, B.; Kneschke, H.; Rossbander, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 4, 151-3(Apr 1972). (In German).

An impartial estimate of the neutron portion of the total dose, to which persons working in the vicinity of a research reactor are exposed, is only possible when consideration is given to operating conditions. The results of radiation field monitoring performed throughout several years on three representative personal categories are as follows: 1. The highest radiation dose is pure γ radiation. 2. The mean annual dose rate equivalent at the RFR is less than 5% of the maximum permissible dose rate. Personnel monitoring is not necessary at the RFR. (auth)

Production Reactors

Refer also to abstracts 51004, 51055, 51056, 52425, 52437, and 52479.

52641 (DPST-72-322) ANALYSIS OF THE SAVANNAH RIVER REACTOR CLOSED-LOOP COMPUTER CONTROL SYSTEM. Gimmy, K. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb 1972. Contract AT(07-2)-1. 39p. Dep. NTIS.

A system for closed-loop computer control of the Savannah River reactors during power ascension and level power operation is in use to improve both safety and productivity of operation. A description of the equipment and program features is presented. 4 references. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 50508, 50567, 50568, 50689, 50731, 50742, 50998–51000, 51003, 51005, 51006, 51008, 51009, 51012, 51017, and 51155.

52642 (DP-Report-596) CALCULATION OF THE RELEASE OF FISSION PRODUCTS FROM TRIPLEX COATED PARTICLES. Progress Report No. 6, August 1966. Project DRAGON. Walther, H. (Atomic Energy Establishment, Winfrith (England)). May 1968. 17p. Dep. NTIS (U. S. Sales Only).

The steady state release of fission products from fuel particles with three layer coatings was calculated and the results are presented in a parametrical form as a function of the relevant release limiting properties. From the results one may recognize quantitatively the importance of a diffusion barrier (formed for example by the usual SiC interlayer of "triplex particles"), for fission products born within the kernel, or born (from fuel contamination) in the different coating layers. Furthermore, the influence of the evaporation coefficient from the particle surface is taken into account. Finally the "partition coefficient" is discussed and a hypothesis is given for its physical interpretation. All the results justify, by theoretical arguments, the use of a SiC interlayer in pyrocarbon coatings, as an alternative to plain carbon coatings. As a conclusion, some suggestions for further theoretical and experimental studies are given. (auth)

52643 (RDT-E-7-6-T(5-72)) PIPE HANGERS, SUPPORTS, AND SNUBBERS FOR LIQUID METAL SERVICE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1972. 22p. RSO.

The requirements are presented for the design, fabrication, quality assurance, inspection testing, certification and delivery of pipe hangers, supports, and snubbers for liquid metal service. The standard applies to the broad term "supporting elements" which encompass the entire range of the various methods used to carry the weight of pipe lines, insulation and the fluid transported as well as any snubbers and braces required to resist imposed vibrations. (auth)

52644 NUCLEAR REACTOR FUEL ROD SUPPORT GRID. Muellner, Frank E.; Sarkozi, Lewis P. (to NUS Corp.). U. S. Patent 3,679,546. 25 Jul 1972. Filed 22 Oct 1968.

A generally rectangular support grid of the egg-crate type is described for laterally supporting intermediate their ends the fuel rods in a nuclear reactor fuel assembly. Substantially perpendicular wall members form a plurality of openings through which nuclear reactor fuel rods are adapted to extend when mounted in a nuclear reactor fuel assembly. Two opposite walls of each opening have inwardly projecting portions which form substantially rigid support surfaces for a rod. A removable spring is mounted on a third wall of each opening for providing a resilient support surface for the rod. Therefore, three surfaces support the rod against lateral movement while providing for axial movement thereof, and the rod is supported at only three areas around any given peripheral section of the rod. The spring is shaped to cooperate with slots mounted in the third wall so that the spring may be easily installed and removed after the wall members have been permanently assembled to form the grid. Therefore, springs made of different material from that of the grid members may be used. In addition, different size springs may be mounted on the third wall of an opening to accommodate warping of the support grid and variations in the diameters of the rods. The third wall also contains means for reliably locking the spring in place during reactor operation. (Official Gazette)

52645 ELASTIC SUPPORT GRID FOR NUCLEAR FUEL ELEMENTS. Warberg, Henrik S. (to Atomic Power Development Associates, Inc.). U. S. Patent 3,679,547. 25 Jul 1972. Filed 16 Dec 1968.

A nuclear reactor fuel element assembly is designed which includes a plurality of elongated fuel members contained in a wrapper tube and supported by a plurality of spaced support grids. Each of the support grids includes grid straps which interconnect to form a grid cell for each fuel member, and each cell has one resilient point of support on each of its four walls for supporting its respective fuel member, the points of support of one grid cell being offset with respect to the points of support of the adjacent grid cell. (Official Gazette)

52646 NUCLEAR FUEL ROD. Leirvik, Raymond M. (to Babcock and Wilcox Co.). U. S. Patent 3,679,545. 25 Jul 1972. Filed 2 Jun 1969.

A nuclear reactor core element is designed utilizing one or more corrugated tubular spacer members that resiliently support and locate within a sealed cladding tube either a fuel body or a neutron absorber body. Each corrugated spacer member is located in a plenum zone within the cladding tube and radially reinforces the tube wall section around such plenum zone against collapse by external fluid pressure. (Official Gazette)

52647 NUCLEAR FUEL. De Boeck, Paul; Marteel, Bernard; Schrijvers, Jozef (to Belgonucleaire, SA). U. S. Patent 3,669,833. 13 Jun 1972. Priority date 29 Sep 1967, Belgium.

A fuel rod is designed which contains a stack of fuel pellets held in position in a lower cladding tube by an inner tube, secured inside the lower cladding tube above the fuel pellets, the inner tube engaging both the upper fuel pellet in the stack and an upper tube. (Official Gazette)

52648 CORE PLUG FOR NUCLEAR REACTOR AND METHOD OF OPERATING REACTOR. Klumb, Ralph H. (to Combustion Engineering, Inc.). U. S. Patent 3,669,834. 13 Jun 1972. Filed 29 Oct 1968.

A core plug for replacing a fuel assembly in a reactor is designed, being devoid of nuclear fuel and having a high flow resistance such as to permit only sufficient coolant flow through it for adequately cooling the plug. In the operation of the reactor, should a fuel assembly within the central region of the core become defective, this defective assembly will be removed and there will be a reshuffling of the fuel assemblies so as to produce an open assembly space at the outermost core region. There will then be placed in this space a core plug having the aforementioned flow characteristics. (Official Gazette)

52649 SEALING DEVICE FOR FUEL ELEMENTS. Aubry, Michel; Deletre, Gerard (to Commissariat a l'Energie Atomique). French Patent 2,085,350. 24 Dec 1971. Filed 13 Apr 1970. (In French).

A sealing device for metallic cladding (e.g., the cladding of nuclear fuel elements) is described. It consists of a plug constructed of hard metal having a circular knife edge at its lower end, which compresses an annular ring of soft metal against a second circular knife edge which is rigidly attached to a hard metal socket welded to the cladding to be sealed. The plug is compressed by one or several elastic metal rings and a flat metal ring when the metal lid is screwed into the socket. (France)

52650 CLOSURE DEVICE FOR A PRESTRESSED CONCRETE VESSEL. Arathoon, J. P. (to Societe pour l'Industrie Atomique). French Patent 2,067,528. 26 Jul 1971. Filed 6 Nov 1969. (In French).

A closing device for a prestressed concrete vessel is described. The vessel is in the form of a cylindrical barrel with at least one open end. This device ensures for a reactor vessel (in particular) a sealed closure with a good resistance at high pressures. The barrel is provided with a ring which defines a reduction in the width of the inside of the vessel, a metallic lid in the form of a spherical cap fixed to this ring, and prestressing screw jacks evenly distributed around the outside surface of the ring. (France)

52651 IMPROVEMENTS TO DEVICES CONTROLLING FLOW, PARTICULARLY THOSE INTENDED FOR NUCLEAR REACTORS. (to Societe Grenobloise d'Etudes et d'Applications Hydrauliques). French Patent 2,077,882. 5 Nov 1971. Filed 20 Feb 1970. (In French).

In certain reactor types, fluid circulates in a large number of interchangeable tubular elements, grouped about a support and fed at their bases with a fluid from a common source. Depending upon its position, a different flow is obtained for each element, the different pressure drops being produced by diaphragms in the different enclosures. Each diaphragm consists of a collar around the base of the tubular element and a collar inside the enclosure. The device presented is intended to facilitate the handling and fitting of the tubular elements and their collars inside the enclosures. The tubular elements are provided with a protection device with a smooth surface, this device having a diameter greater than that of the collar at the base, but less than that of the base enclosure. The device extends over the entire length of the base and penetrates into the enclosure. It consists of either a cylindrical can or three radial walls. An exact height and angular positioning of the base in its enclosure is envisaged. (France)

52652 INTEGRATED CHARGING MACHINE FOR NUCLEAR REACTOR. Costes, Didier (to Commissariat a l'Energie Atomique). French Patent 2,085,211. 24 Dec 1971. Filed 6 Feb 1970. (In French).

Certain nuclear reactors have a free space above the core in the reactor vessel. It is in this space that a charging machine is installed, the charging process being accomplished by a gripping grapnel, which descends into the vertical channels of the core. Integrated machines having a rotating radial arm, which necessitate a radial displacement system for the part sliding or rolling on the arm (wagonnet) and a vertical displacement control mechanism for the grapnel, are considered. The radial drive system of the wagonnet has been simplified. (France)

52653 FUEL ELEMENT FOR ATOMIC REACTORS. Bigge, W. B.; Roupe, G. A.; Lass, J. L.; Dominic, A. V. (to General Electric Co.). Norwegian Patent 166,011. 15 Dec 1966. Priority date 17 Jan 1966, United States. (In Norwegian).

In order to compensate for slight differences between the desired reactivity properties of a new fuel charge and the actual properties of the fuel as designed based on earlier data, it is proposed that a number of fuel pin locations along, and symmetrically perpendicular to, the main diagonal of a square lattice fuel assembly be arranged so that the fuel pins are easily removable. The reactivity may then be adjusted by replacing standard fuel pins by pins with higher or lower enrichment or by pins containing burnable poison. A locking system is shown wherein a locating collar on the upper grid plate has a slot and a recess to accommodate a pin on a spring-loaded sleeve on the top end of the fuel pin. This forms a kind of bayonet mechanism. A number of examples are given illustrating the applications of the invention. (Norway)

52654 NUCLEAR REACTOR CONTROL USING NEUTRON ABSORBING GAS. Nicholson, F. D. (to United Kingdom Atomic Energy Authority). Canadian Patent 898,422. 18 Apr 1972.

Means for circulating a carrier gas and neutron-absorbing gas such as ^{3}He, Kr, or Xe were provided in a closed circuit bounded by the coolant-conducting tubes and the calandria tubes of a pressure-tube reactor. By having pressurized sources of the two gases and a by-pass system with compression and cooling means for separation of the gases, the proportions of the gas constituents can be varied in order to vary the reactivity of the reactor. The gas mixture need only be circulated at low pressure, simplifying the construction of suitable seals between the coolant-conducting tubes and the calandria tubes. (Canada)

52655 DEVICE FOR CHARGING AND DISCHARGING A REACTOR CORE. de Temple, B.; Schramm, K. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,464,743. 13 Jan 1972. (In German).

The device is composed of telescopic and essentially cylindrical guide tubes for a lifting and lowering mechanism of a gripping device attached to the free end of a central telescope element. The lifting and lowering mechanism consists of an inseparable and entirely movable combination of at least two thrust chains. (GF)

52656 LOADING DEVICE FOR FUEL ELEMENTS AND CONTROL RODS IN A REACTOR. Krueger, J.; Schabert, H. P.; Schubert, F.; Weber, R. (to Siemens AG). German Patent 1,764,176. 5 Jan 1972. (In German).

A description is given of a loading machine comprising a vertically movable double gripping device, consisting of a separately manipulable control rod gripping device and of a fuel element gripping device. (GF)

52657 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. (to Maschinenfabrik Andritz Aktiengesellschaft). British Patent 1,274,953. 17 May 1972. Priority date 30 Jul 1968, Austria.

An installation for purifying a reactor coolant is described in which pump sealing difficulties are avoided by using the leakage fluid itself for purification purposes. The main pump has a shaft and sealing elements; the coolant leaking from the pump is cooled in a heat exchanger and then flows back through the sealing elements to an after cooler, a purifier unit, and a high-pressure pump for return to the main circuit via the heat exchanger. (D.L.C.)

52658 IMPROVEMENTS TO CONTROL EQUIPMENT FOR NUCLEAR REACTORS. (to Societe Franco-Americaine de Constructions Atomiques). French Patent 2,081,077. 3 Dec 1971. Filed 3 Mar 1970. (In French).

Improvements made to measuring and monitoring equipment for nuclear reactions with cores in pressure vessels, surrounded by shielded enclosures, are described. The neutron-flux-measurement instrumentation consists of detectors that can be moved to different positions on the fuel charge inside the guide tubes which are withdrawn from the core during loading of the fuel elements. The measurement room is situated below the plane of the opening in the reactor vessel, the tubing being sealed into the shielded enclosure. The end of each tube is provided with an adjustable device which acts between the inner wall of the tube and the outer wall of the corresponding guide tube and is capable of shutting off at the pressure existing within the reactor vessel during the operation of the reactor when the tube is blocked or when the reactor is shut down in a position allowing the sliding of the guide tube. (France)

52659 SEALING DEVICE FOR THE LID OF A VESSEL HAVING A CIRCULAR ORIFICE. (to Compagnie Industrielle de Travaux). French Patent 2,079,545. 18 Oct 1971. Filed 4 Feb 1970. (In French).

A sealing device for the lid of a prestressed concrete vessel having a circular orifice is described. The device consists of an Ω shaped section having one of its ends attached to the lid and its other end extended by a flange intended to press against a seating provided inside the vessel. The device is provided with a spring which is compressed between the flange and the lid. (France)

52660 IMPROVEMENTS TO PRESSURIZED PRESTRESSED CONCRETE VESSELS. (to Compagnie Industrielle de Travaux). French Patent 2,079,528. 18 Oct 1971. Filed 4 Feb 1970. (In French).

Vessels for enriched-U reactors are presented. The removable prestressed concrete lid of these vessels is applied under pressure to the vessel using a certain number of prestressed shafts passing through longitudinal channels provided in the wall and the corresponding channels passing through the lid. Demountable pressure devices are provided which act between the lid and the bottom of the vessel. Each longitudinal channel is extended by a rigid tube which guides the shaft and is fixed to the vessel. The cross section of this tube is less than that of the corresponding lid channel. This tube is placed in the channel during the positioning of the lid on the reactor vessel. (France)

52661 FUEL PIN WITH SODIUM BONDING. Ernst, H. (to Licentia Patent-Verwaltungs GmbH). German Patent 2,032,030. 13 Jan 1972. (In German).

A description is given of a fuel pin with sodium bonding for a sodium-cooled reactor, which has an opening at the head end as well as a gas-permeable throttle mounted to that opening, having a very high flow resistance for liquid sodium and a very low flow resistance for gases. The bottom end of the pin is also provided with an opening for pressure balance between the interior and the coolant at the foot of the pin. (GF)

52662 REACTOR CONTROL ROD DRIVE. Kuenzel, H.; Pawlitzki, R.; Schilling, D. (to Siemens AG). German Patent 2,031,913. 13 Jan 1972. (In German).

A description is given of a motor-driven spindle drive for the vertical movement of a control rod, preferably used in liquid-metal-cooled reactors, mounted on a lever system by means of a bayonet mounting. The revolving cover of the reactor vessel is rigidly fixed to a control-rod-bearer plate which contains the plug connections for the energy supply as well as the pilot wires, with a clearance being provided between the cover and the bearer plate. (GF)

52663 NUCLEAR REACTOR CORE MONITORING SYSTEM. (to Babcock and Wilcox Co.). British Patent 1,276,993. 7 Jun 1972. Priority date 11 Jun 1970, United States.

A reactor instrumentation arrangement is described which makes it easy to insert and remove the instrumentation from the reactor. A passage extending into the core from a handling station outside the reactor is provided, and a slender, flexible instrumentation assembly of thermocouples and radiation detectors is movable within the passage. A hollow tube is also provided within the assembly for the insertion of a standard neutron flux detector for periodically calibrating the other neutron flux detectors. Means for sealing the assembly and for driving the calibration detector are also described. (D.L.C.)

52664 IMPROVEMENTS IN AND RELATING TO HEAT INSULATED VESSELS. Errington, Thomas (to Whessoe Ltd.). British Patent 1,274,351. 17 May 1972. Filed 16 Jan 1970.

Reference is made, in particular, to nuclear vessels having internal heat insulation panels, such as for concrete pressure vessels. It is the practice to build up the insulation in layers, and in order to protect these layers from the effects of gas flow and attendant vibration it is necessary to install some form of skin on the inside face, normally in the form of cover plates. These plates are subject to thermal expansion and contraction, and the method of fixing must allow for this. In the arrangement described the plates are secured by a number of retainers, each comprising a peg fastened to the wall of the vessel, and each peg carries a positioning arm which engages the plate and has greater resistance in the direction towards and away from the wall than in the direction normal to the peg. In the latter direction the arm is yieldable to allow relative displacement of the associated plate and peg due to expansion and contraction, and in the former direction holds the plate against the insulation. (UK)

52665 PRESTRESSING DEVICE FOR AN ENCLOSURE OR VESSEL RESISTANT TO HIGH PRESSURES. Picaut, Jack; Puyo, Andre; Rouge, Pierre; Saglio, Robert (to Commissariat a l'-Energie Atomique). British Patent 1,274,407. 17 May 1972. Priority date 30 Jan 1970, France.

A device for transversely prestressing the wall of a reactor pressure vessel is described, in which the diameter of the prestressing hoops is relatively close to the external diameter of the vessel. Bed plates are interposed between the hoops and the vessel wall at spaced points. Jacks are located at these points for exerting inward radial pressure on the vessel and outward radial pressure and longitudinal tension on the hoops through gripper arms whose flanges engage shoulders on the bed plate. A single jack carried by supporting legs straddling the hoop and bed plate is also provided, and it includes a piston and a cylinder. Chocks are interposed between the bed plates and the vessel after the hoops have been tensioned by the jacks. (D.L.C.)

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52666 (AEEW-M-1010) SPECTRE: A CROSS-SECTION CONDENSATION AND SPECTRUM RECYCLING SCHEME FOR CARRYING OUT WHOLE-REACTOR TRANSPORT CALCULATIONS. Kendall, K. C.; Cobley, T. H. (Atomic Energy Establishment, Winfrith (England)). Apr 1971. 18p. Dep. NTIS (U. S. Sales Only).

The reactor assembly HECTOR was used to study the temperature coefficient of reactivity of Mk III GCR fuel. Due to the large spatial variations in the neutron spectrum produced by regions of unlike fuel contained in these experiments, standard methods of analysis using existing methods were found inadequate. The cross-section condensation and spectrum recycling scheme SPECTRE was developed to analyze the experiments. (auth)

52667 (AEEW-R-751) ANALYSIS OF REACTIVITY MEASUREMENTS IN MULTI-REGION REACTORS. Bannerman, R. C. (Atomic Energy Establishment, Winfrith (England)). Dec 1971. 53p. Dep. NTIS (U. S. Sales Only).

The analysis of reactivity measurements in multi-region reactors, where the neutron energy spectrum may be a continuously varying function of position, is considered initially in general terms. Direct and variational methods of calculating individual core reactivities and the perturbation method of calculating reactivity changes are described, and the accuracy of each is assessed. Particular attention is paid to the development of these methods in the multigroup forms required in practice, and a commonly occurring source of error in the use of the perturbation expression is noted. Some points arising in connection with the measurement of reactivity are then considered. Finally, the SPECTRE scheme, which was developed for the analysis of temperature coefficient measurements on Mk III GCR fuel in the zero-power reactor HECTOR, is described in outline. (auth)

52668 (AEEW-R-786) SOME INTEGRAL PROPERTIES OF NUCLEAR DATA DEDUCED FROM WIMS ANALYSES OF WELL THERMALISED URANIUM LATTICES. Kemshell, P. B. (Atomic Energy Establishment, Winfrith (England)). Apr 1972. 23p. Dep. NTIS (U. S. Sales Only).

For clean, uniform, well thermalized uranium lattices the accuracy of the WIMS lattice cell code is limited more by errors in the basic nuclear data used than by approximations in the physics methods. It has thus been possible to infer certain integral properties of these nuclear data from a series of calculations, using consistent method and data options, which have been performed for a range of some twenty carefully chosen experiments covering a variety of uranium fuel types and the three principal moderators. It is shown that a reduction in ^{238}U capture resonance integral, relative to that given by the basic nuclear data, is required to produce consistently accurate calculations of resonance capture for all three moderators; and there is some, as yet inconclusive, evidence in support of a hardening of a conventional fission spectrum. When allowance is made for the foregoing factors a residual underprediction of reactivity is noted, which is most marked for the more thermalized heavy water lattices, and which is thought to be due to errors in the energy dependence of ^{235}U thermal cross-sections. (auth)

52669 (ANL-7716) ARC SYSTEM TWO-DIMENSIONAL DIFFUSION THEORY CAPABILITY, DARC2D. Daly, T. A.; Leaf, G. K.; Kennedy, A. S. (Argonne National Lab., Ill.). May 1972. Contract W-31-109-eng-38. 483p. Dep. NTIS.

Presented is the documentation of the ARC System two-dimensional diffusion theory capability, DARC2D, comprising the k-effective and source calculation module DIF2D (NUC005) and the criticality search module D2DSCH (NUC006). Both modules solve a finite difference approximation to the two-dimensional multigroup diffusion equation. The DIF2D module can perform either inhomogeneous or homogeneous calculations, using either real and/or adjoint solutions. Six geometry types, RX, ZR, XY, $R\theta$ and 2 triangular meshes, are permitted. The criticality search module allows searches to a fixed value of k-effective or of the inverse reactor period α. The parameters which may be varied are composition cross section data, mesh interval length in each dimension or region size, reactor buckling, and the inverse period α. (auth)

52670 (CEA-R-2814) ALECTO: RESULTS OBTAINED WITH HOMOGENEOUS CRITICAL EXPERIMENTS ON ^{239}Pu, ^{235}U, AND ^{233}U. Bruna, Jean-Georges; Brunet, Jean-Paul; Caizergues, Robert; Clouet d'Orval, Christian; Kremser, Jacques; Tellier, Henry; Verrier, Philippe (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1965. 139p. (In French). Dep. NTIS (U. S. Sales Only).

The results of the homogeneous critical experiments ALECTO, made on plutonium 239, uranium 235 and uranium 233, are presented. After a brief description of the equipment, the critical masses for cylinders of diameters varying from 25 to 42 cms are given and compared with other values. Experiments relating to cross sections and constants to be used on these materials are presented. Kinetic experiments allow the comparison of compare pulsed neutron methods to fluctuation methods. 26 references. (auth)

52671 (CISE-R-194) SIMPLIFIED, INTEGRAL METHOD FOR NEUTRON THERMALIZATION IN A URANIUM-D_2O LATTICE WITH PLUTONIUM. Bonalumi, R.; Palazzi, F.; Pierini, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1967. 51p. INIS.

Declassified 1971.

A simplified model is described for the calculation of two-group effective cross-sections in a uranium-D_2O lattice where the fuel may contain Pu isotopes and cooling is provided by a high temperature hydrogeneous coolant. Spectrum in the fuel region is evaluated analytically by assuming a Westcott type spectrum in the moderator, and by a separate treatment of the fuel induced distortions in its Maxwellian and epithermal components. Main features of the method are: (1) the use of first collision probabilities in the fuel element (with parabolic source) and diffusion theory in the moderator; (2) the use of integral, though simplified, scattering kernels in the fuel region to describe both slowing-down and thermalization. As a result, the thermal spectrum in the fuel is obtained analytically and the epithermal cross sections automatically include the relevant disadvantage and shielding factors, which are dependent on the amount of ''internal'' moderation. Some comparison with experiments and with THERMOS calculations is also reported, showing the accuracy of the model: each problem takes about 2 sec on the IBM 7040 digital computer. (INIS)

52672 (CISE-R-195) TWO-GROUP CALCULATION OF THE FAST FISSION FACTOR IN A LATTICE WITH CLUSTERED FUEL ELEMENTS. Bonalumi, R.; Palazzi, F.; Pierini, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1967. 31p. INIS.

Declassified 1971.

A synthetic method is described for the calculation of the fast fission factor in a lattice with clustered fuel elements. The fast fission factor is defined as the number of neutrons being slowed-down past 0.1 MeV throughout a lattice cell per neutron arising there from fission below 0.1 MeV, in an infinite lattice. Such a definition is well adapted to a 4 group-lattice code, but implies that cell-to-cell interaction, (n,2n) reactions and back-scattering effects should be carefully accounted for. Such requirements are met by dividing fast neutrons into two groups (above and below the ^{238}U fission threshold), and by using a first collision probability scheme, where non-uniformity of sources in the fuel elements and in the moderator is explicity taken into account. (INIS)

52673 (CISE-R-200) MONOS: A CODE FOR THE VARIATIONAL SYNTHESIS SOLUTION OF TWO-GROUP DIFFUSION EQUATIONS IN r,z GEOMETRY WITH MONO-SEPARABLE FLUX APPROXIMATION. Bruschi, C.; Foresti, G.; Pierini, G.; Rubbia, S. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1966. 82p. INIS.

Declassified 1971.

A code is presented which synthesizes the two-dimensional two group flux of a cylindrical reactor out of one-dimensional solutions of the diffusion equations. The monoseparable flux approximation $\Phi_k(r,z) = u_k(r)v_k(z)$ is made, where $v_k(z)$ are the trial functions and $u_k(r)$ the weight functions, or vice versa. However the solution does not depend on the trial, as an iterative procedure is used, for which the obtained weight becomes the trial for evaluating a new weight function and so on, until the eigenvalue convergence is reached. Moreover an analytical method provides the one dimensional solutions, thus allowing for the variation of all the macroscopic coefficients with respect to the control parameter. A check against exact two-dimensional codes is also reported in order to assess the physical reliability of MONOS for two-dimensional reactor studies. (INIS)

52674 (CISE-R-224) PROCIONE: A CODE FOR EVALUATING THE FUEL COMPOSITION AND REACTIVITY CHANGES WITH IRRADIATION OF A LATTICE CELL. Bonalumi, R.; Palazzi, F.; Pierini, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1967. 135p. INIS.

Declassified 1971.

The code PROCIONE is described, which calculates the fuel composition and reactivity following the neutron irradiation of a lattice at a constant power level. Essentially, such a code embodies the PROCELLA code and the depletion and buildup equations giving the changes in fuel composition from increasing irradiation. Also the input-output of the code is described, together with Canadian data, both experimental (NRX uranium metal rod, reactivity and isotopic composition) and calculated (NPD and CANDU-BLW uranium dioxide clusters, isotopic composition). The running time of the code is of about 35 sec per irradiation point on the IBM-7040 computer. (INIS)

52675 (CISE-R-231) CHEYENNE: A HETEROGENEOUS DIFFUSIVE CODE FOR FINITE CYLINDRICAL SMALL REAC-

TORS. Pedretti, F.; Rubbia, S. (Centro Informazioni Studi Esperienze, Milan (Italy)). Apr 1967. 55p. (In Italian). INIS. Declassified 1971.

The code CHEYENNE is devised for the study of small dimension reactors by the heterogeneous method; the Feinberg–Galanin approach is used. The physical model adopted assumes three group (fast, resonance and thermal) diffusion theory for the moderator, however the equations are written in a form which can be easily generalized to multigroup diffusion theory. In order to calculate reactors with finite dimensioned reflectors, the Feinberg–Galanin rod-rod interaction kernel has been slightly modified. Further features are the possibility of taking into account localized absorptions in all groups, the epithermal fissions and the slowing-down in the fuel element. Furthermore the code is able to deal both with regular lattices and with local effects such as the insertion of control rods. Its limits are the number of groups (three) and the maximum allowed number of classes (twenty-five). (INIS)

52676 (CONF-720901–7) VERIFICATION OF A NEW METHOD FOR CALCULATING AND MEASURING GENERATOR TIME IN A SUBCRITICAL FAST REACTOR. Buhl, A. R. (Oak Ridge National Lab., Tenn.); Robinson, J. C. (Tennessee Univ., Knoxville). 1972. 14p. Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

A new method for calculating and measuring the generation time (Λ) in a subcritical fast reactor using a recently developed transfer and scattering kinetics scheme (TASK) is described. The method is an extrapolation of a four-node fluctuations theory in which the generation time in a thermal reactor was shown to be equal to the slope of the tangent of the phase angle from the power spectra between a high-energy-sensitive and low-energy-sensitive detector. The TASK method directly computes the prompt die-away time constant and the Λ based on the tangent method. Present experimental techniques do not provide a direct measure of Λ for subcritical states. To substantiate the TASK calculations, Λ was compared with the experimental value at critical and Λ was computed using the standard lambda (λ) mode and omega (ω) mode definitions for critical and for three subcritical states of the Fast Test Reactor. 10 references. (auth)

52677 (KFK–1534) SEVERAL NEW METHODS FOR ADOPTION OF DIFFUSION THEORY IN COMPLICATED NEUTRON PHYSICAL PROBLEMS WITH HEAVY WATER REFLECTED REACTORS WITH COMPACT CORE IN COMPARISON WITH EXPERIMENTS. Scharmer, Klaus (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Dec 1971. 115p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ. (West Germany).

In nuclear reactors with compact, externally moderated cores and large heavy-water reflectors elementary diffusion theory is no longer valuable. Some methods are described as to how group constants can be determined, so that with few group diffusion theory the nuclear lay-out parameters can be correctly determined. The group flux is a linear combination of several "neutron families" having characteristic spectra. With the first method "neutron families" diffuse independently, with the second method mutual interaction occurs. The group constants are determined by utilizing zero- and one-dimensional exact calculations. A new method has been developed for calculations of three-dimensional safety-rod geometries. All theoretical results are compared with measurements obtained by critical experiments. (77 references) (auth)

52678 (NP–19317) STUDY OF A STOCHASTIC TWO-GROUP MODEL FOR NUCLEAR REACTORS INCLUDING NEUTRON AND GAMMA DETECTION. Baers, Bruno (State Inst. for Technical Research, Otaniemi (Finland). Reactor Lab.). Feb 1972. 55p. (In Swedish). Dep. NTIS (U. S. Sales Only).

The relative correlation amplitudes (B_1/A and B_2/A) and relaxation constants (α_1 and α_2), associated with the detection of gamma quanta as well as thermal and fast neutrons, have been studied theoretically, and calculated for a big undercritical ($k = 0.788$) water moderated natural uranium reactor. The form of the studied correlation functions are $A + B_1 \exp(-\alpha_1 t) + B_2 \exp(-\alpha_2 t)$, where B_1 and α_1 are associated with the fast neutron group, and B_2 and α_2 with the thermal group. The results have been compared with the available experimental data. The agreement between calculations and measurements varies from good to poor. The results contribute to a verification of the validity of the model within the limits of the assumptions, but reflect also the limited possibilities of utilization of a big reactor core. On the basis of this study most of the relative amplitudes B_1/A and B_2/A are measurable in the reactor in question as far as suitable detectors are available. The spontaneous relaxation phenomena associated with the fast neutron group can be observed by photon detection. The hardly realizable detection of fast neutrons, and also the detection of thermal neutrons can be substituted for photon detection for observation of relaxation constants. 21 references. (tr-auth) (Finland)

52679 (UJV–2834–F) NUCLEAR REACTOR CALCULATION IN A ONE-DIMENSIONAL MULTIGROUP DIFFUSION APPROXIMATION BY GALERKIN'S METHOD USING A BASIC SYSTEM OF COORDINATE FUNCTIONS. Tinka, I.; Chermak, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

A calculation of one-dimensional multigroup diffusion equations based on Galerkin's method is presented. The method makes use of a special system of coordinate functions appearing in Galerkin's procedure and also makes use of a small computer. The program has been written in Gier–Algol for the GIER computer. The method is illustrated by a numerical example of a fast reactor. (5 references) (auth)

52680 (WAPD–TM–997) ANALYSIS OF THE FISSION NEUTRON SPECTRUM OF ^{233}U AND CRITICALITY COMPUTATIONS FOR HOMOGENEOUS ^{233}U–H_2O SPHERES AND CYLINDERS. (LWBR Development Program). Steen, N. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jun 1972. Contract AT-11-1-GEN-14. 47p. Dep. NTIS.

The calculation of criticality of ^{223}U fueled, aqueous-nitrate spherical critical experiments and a high leakage cylinder experiment is discussed. The calculated reactivities are found to be in excellent agreement with experiment, being well within the limit (±0.25 percent) caused by uncertainties in the fuel inventories (±0.50 percent). The average error in calculated reactivity is found to be 0.06 percent, for the 11 assemblies considered. Previously, the spheres were analyzed with calculated reactivities being in error by as much as 0.69 percent. The cylindrical experiments were also part of a set of criticals analyzed with detailed Monte Carlo calculations in which errors as large as 3 percent in eigenvalue were found for high (50 percent) leakage assemblies. It is concluded that the principal sources of error in the previously calculated eigenvalues are the description of the fission spectrum, representation of the total neutron cross sections above approximately 8 MeV, and nonthermal absorption cross sections. The least significant error is found to be due to the ^{233}U thermal cross-section representations. Because of the significance of the fission spectrum, the method of analysis is discussed in detail. (48 references) (auth)

52681 (Y-DR–85) MONTE CARLO CALCULATIONS OF NEUTRONIC PROPERTIES FOR UNMODERATED CUBIC ARRAYS OF URANIUM (93.2) METAL CYLINDERS. Mihalczo, John T. (Oak Ridge National Lab., Tenn.). 6 Jul 1972. Contract W-7405-eng-26. 20p. Dep. NTIS.

The fission density distributions, mean times to loss and to fission, the neutron multiplication factors of the arrays, the coupling coefficients between units, and the neutron multiplication factor of the individual units in unreflected and unmoderated arrays of uranium metal cylinders were calculated by Monte Carlo methods. The neutron multiplication factor of a particular cylinder in the array was not a strong function of position in the array or the size of the array. Simple calculational models used to predict criticality of arrays of fissionable material, which assume the multiplication factor of a cylinder in an array is the same as that for an isolated cylinder, may be in error since the fission density is larger near the surface for a cylinder in an array. Because of this change in fission density distribution, the multiplication factor of a single cylinder in an array was as much as 5% lower than that for an isolated cylinder. The coupling coefficient between a pair of cylinders was larger in the direction toward the cylinder with the larger fission density. (auth)

52682 HANDBUCH DER KRITIKALITAET. TEIL I. KRITIKALITAET UND NUKLEARE SICHERHEIT. TEIL II. DATEN ZUR KRITIKALITAET. (Handbook of Criticality. Part I. Criticality and Nuclear Safety. Part II. Criticality Data). Thomas, W.; Weber, W. Munich; Technische Universitaet (1971). 189p.

Part I includes: fission process, multiplication factors, most important criticality parameters, nuclear safety, safety factors, physical data. Part II contains criticality parameters for fissile materials as metals, oxides and nitrates in aqueous systems. Further data are given for $UO_2-ThO_2-H_2O$ and homogeneous $Pu-H_2O$ systems with pure ^{239}Pu or 95% ^{239}Pu, 5% ^{240}Pu. (INIS)

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Law

Refer also to abstracts 52238 and 52427.

52683 (HMI-B-122) ANNUAL REPORT, 1971. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). May 1972. 82p. (In German). Dep. NTIS (U. S. Sales Only).

Brief summaries of research in nuclear chemistry, radiation chemistry, nuclear physics, solid state physics, theoretical nuclear physics, radiation physics, data evaluation, electronics, and mathematics are presented. Publications issued during 1971 are listed. (H.B.G.)

52684 (INS-TS-8) RECORDS OF RADIATION EXPOSURE CONTROL, 3. **Ishihara, T.; Kawabata, H.; Bando, I.** (Tokyo Univ. (Japan). Inst. for Nuclear Study). 11 Oct 1971. 63p. (In Japanese). NTIS (U. S. Sales Only).

The records of environmental and personal monitoring of radiation exposure at the Institute for Nuclear Study are accumulated for the period during April 1969 to March 1971. The technical details of the monitoring program and other developmental activities in the Radiation Control Center are included. (auth)

52685 (JAERI-M-4517) QUARTERLY REPORT OF HEALTH AND SAFETY AT OARAI RESEARCH ESTABLISHMENT, 14. (Japan Atomic Energy Research Inst., Tokyo). Jul 1971. 59p. (In Japanese). NTIS (U. S. Sales Only).

The quarterly report of radiation protection activities at Oarai Research Establishment for the period of January 1 to March 31, 1971 is presented. Major data to be preserved permanently are also given in a summary for the fiscal year 1970. (auth)

52686 (NP-19343) ON THE LAW ON ATOMIC ENERGY ACTIVITIES. (Industridepartementet, Oslo (Norway)). 1971. 74p. (In Norwegian). Dep. NTIS (U. S. Sales Only).

Following a brief introduction on the background for the proposed law, the composition and mandate of the committee on whose report the proposal is based are given. A short survey of the nuclear legislation in Sweden, Finland, Denmark, the United States and the United Kingdom is followed by a summary of existing Norwegian legislation applicable to nuclear installations. Norwegian work on nuclear safety is briefly described. A working prognosis for the introduction of nuclear power in Norway is that by 1975 one plant will be under construction and in 1980 one plant will be operating with others in various stages of planning and construction. The potential hazards of nuclear installations are summarized and the main provisions of the Paris and Vienna Conventions are outlined. The need for and principles of an Atomic Energy Law are discussed and the views of various public bodies given. Explanatory remarks on the proposed law and its various paragraphs form an introduction to the draft of the law itself. Following definitions of the technical terms, the requirement for concessions and permits are stated, and the composition and authority of the National Atomic Inspection are defined. Liability and insurance requirements are stated and other general rules given. (Norway)

52687 (WP-35(Rev.3)) MUTUAL EMERGENCY ASSISTANCE FOR RADIATION ACCIDENTS. (International Atomic Energy Agency, Vienna (Austria)). 1971. 221p. Dep. NTIS (U. S. Sales Only).

Data are summarized on the nature and extent of the assistance that Member States of the following organizations: the Food and Agriculture Organization of the United Nations; the International Labor Organization; the World Health Organization; and the International Atomic Energy Agency might be able to make available, on request, in the event of a radiation accident in the territory of another State. (auth)

Miscellaneous

52688 (AAEC/E-219(Pt.2)) POTENTIAL-pH DIAGRAMS AT TEMPERATURES ABOVE 298.16°K. PART 2. POTENTIAL-pH DIAGRAMS OF WATER FOR THE TEMPERATURE RANGE 298.16 TO 573.16°K. Lowson, R. T. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1972. 39p. Dep. NTIS (U. S. Sales Only).

52689 (AAR-87) QUADRATICALLY CONVERGENT ALGORITHMS AND ONE-DIMENSIONAL SEARCH SCHEMES. Huang, H. Y.; Chambliss, J. P. (Rice Univ., Houston, Tex.). 1972. 26p.

52690 (AE-438) STUDIES CONCERNING WATER-SURFACE DEPOSITS IN RECOVERY BOILERS. Strandberg, O.; Arvesen, J.; Dahl, L. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nov 1971. 128p. Dep. NTIS (U. S. Sales Only).

52691 (AE-454) MEASUREMENT OF BONE MINERAL CONTENT USING RADIATION SOURCES. An Annotated Bibliography. Schmeling, Per (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jun 1972. 65p. Dep. NTIS (U. S. Sales Only).

The literature has been searched for articles covering the use of radiation sources for determining bone mineral content in vivo and in vitro. This annotated bibliography represents the work in the field and covers the years 1963 to 1971. (auth)

52692 (AECL-4128) PDP8A: A PROGRAM TO ASSEMBLE PROGRAMS FOR THE PDP-8 COMPUTER. **Goulding, D. B.** (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1972. 83p. Dep. NTIS (U. S. Sales Only). AECL $2.00.

52693 (AECL-4158) CRNL VERSION OF THE SIMULATION PROGRAM MIMIC. **Carver, M. B.** (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1972. 15p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

52694 (ANCR-1072) ATR DATA SYSTEM OPERATIONAL GUIDE. VOLUME 1. CDC-636 COMPUTER SYSTEM. Tappendorf, J. C. (ed.) (Aerojet Nuclear Co., Idaho Falls, Idaho). Jun 1972. Contract AT(10-1)-1375. 54p. Dep. NTIS.

52695 (ANL-7826) CHINESE REMAINDER AND INTERPOLATION ALGORITHMS. Lipson, John D. (Argonne National Lab., Ill.). Jul 1972. Contract W-31-109-eng-38. 54p. Dep. NTIS.

52696 (AWRE-O-42/72) MCCOY AND SIMLA: GENERAL PURPOSE PROGRAMS FOR ONE-DIMENSIONAL UNSTEADY COMPRESSIBLE FLUID FLOW. **Hoskin, N. E.** (Atomic Weapons Research Establishment, Aldermaston (England)). Jul 1972. 9p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

52697 (BDX-613-607(Rev.)) HELICAL TAPE WINDER. Andrews, C. E. (Bendix Corp., Kansas City, Mo.). Apr 1972. Contract AT(29-1)-613. 16p. Dep. NTIS.

52698 (BNL-17054) BROOKNET-2: BROOKHAVEN ONLINE COMPUTER NETWORK. Campbell, Graham; Fuchel, Kurt; Padwa, Larry (Brookhaven National Lab., Upton, N. Y.). Jul 1972. 42p. Dep. NTIS.

52699 (BNL-17106) URBAN AIR POLLUTION IN A SUBURBAN ENVIRONMENT. Raynor, Gilbert S. (Brookhaven National Lab., Upton, N. Y.). 1972. 4p. Dep. NTIS.

52700 (BNWL-SA-4352) PARTITIONING OF THE BIAS OF THE JOLLY-SEBER CAPTURE-RECAPTURE ESTIMATE OF POPULATION SIZE WHEN UNEQUAL CATCHABILITY IS PRESENT. **Gilbert, Richard O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 1972. Contract AT(45-1)-1830. 16p.** (CONF-720643-1). Dep. NTIS.

From Western regional meeting of the WNAR, IMS, and ASA; Seattle, WA. (19 Jun 1972).

52701 (CALT-767-P-3-26) COMPUTER ENHANCEMENT OF HIGH RESOLUTION ELECTRON MICROGRAPHS CONTAINING WEAK PERIODIC INFORMATION. Horgen, H. M.; Villagrana, R. E. (California Inst. of Tech., Pasadena); Maher, D. M. (Bell Telephone Labs., Inc., Murray Hill, N. J.). [nd]. 10p. Dep. NTIS.

52702 (CEA-CONF-1972) COMPUTATION OF THRESHOLD IN THIN SEMICONDUCTOR LAYERS. Duchene, J.; Adam, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 13 Sep 1971. 14p. (In French). (CONF-710932-4). Dep. NTIS (U. S. Sales Only).

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CSS is a digital computer program developed to allow ecologists with minimal training in mathematics and computer programming to construct and test a wide variety of ecosystem models. Nonlinear and time-dependent functions are permitted for transfers between storage components; however, the models must be predominantly continuous. Sources and sinks may be defined. Concepts necessary for program use are discussed, including preparation of program input and interpretation of program output. Two test cases and a listing of the program are provided. (auth)

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Germanic	ä appears as	ae
Germanic	ö	oe
Germanic	ü	ue
Scandinavian	ø	oe

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SUBJECT INDEX

Cross references are included in cumulative subject indexes and in *Subject Headings Used by the USAEC Technical Information Center* (USAEC report TID-5001).

The reader is also referred to *Guide to Abstracting and Indexing for Nuclear Science Abstracts* (USAEC report TID-4576).

Most headings in the subject index are the names of specific materials, things, and processes. Each heading is followed by a modifier that describes the properties of, or processes applied to, that heading.

All index entries cite *NSA* volume and abstract numbers; volume number precedes the colon and the abstract number follows it. The designation (R) following the abstract number indicates a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Report numbers, where applicable, are included in parentheses after the abstract number of the citation. Published literature (journal article or book) can be identified by the absence of a report number.

Ideas presented in the original literature, rather than key words, have been indexed. The indexers have selected what seemed the most probable and logical place to look for typical information. Since it is not always possible to anticipate where a user would look for information, the cumulative indexes include numerous cross references. Consideration of synonymous or closely related terms will prove valuable.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use or to the general class headings that include the specific headings. For example, information on boiler design for the Fermi Fast Breeder Reactor would be indexed under the headings BOILERS and FERMI FAST BREEDER REACTOR but not necessarily under the headings REACTORS, FAST or REACTORS, BREEDER.

General or broad headings are reserved for general summaries, reviews, comprehensive reports, and similar literature.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings; e.g., AMINO ACIDS rather than ACIDS, AMINO; HELIUM ISOTOPES He-4 rather than HELIUM—ISOTOPES He-4 or HELIUM—He-4 ISOTOPES. Note, however, that in some cases parenthetic modifying terms or inverted headings such as NEUTRONS, FAST, are used where the alphabetical arrangement of a direct entry would cause information to be scattered. In addition, organic compounds are usually entered in the index in the inverted form to facilitate grouping like or related compounds with the parent compounds; e.g., BENZENE, BROMO- rather than BROMOBENZENE.

Alphabetization

Subject headings are alphabetized word by word. Parenthetic qualifiers, numbers, and Greek letters within subject headings are disregarded in alphabetizing unless there are two or more headings that are otherwise identical, in which case the qualifier, numerical progression, or spelled names for the Greek letters determine the order.

Examples:

M-Capture
  see ELECTRON CAPTURE
MAGNESIUM
MAGNESIUM ALLOYS AND SYSTEMS
MESONS
MESONS (*)
MESONS (rho)
1-PENTANOL
2-PENTANOL
URANIUM OXIDES
URANIUM OXIDES UO_2

Modifying Phrases

The modifiers appearing under a subject heading are written specifically to show the relation between the item being indexed and the heading. The modifier therefore contains a maximum of useful information. Although the modifier begins with the word judged to be of greatest use to the greatest number of users, there is still need for the searcher to consider all modifiers under the heading(s) of interest.

Modifiers usually form meaningful phrases when combined with the subject heading. Some are intended to be read following the subject heading, e.g., the entry HYDROGEN—*sorption by charcoal,* should be read *hydrogen sorption by charcoal.* As a result of placing the important word first, however, many modifiers must be rearranged for smooth reading, e.g., FORMALDEHYDE—*yields in radiolysis of ethyl ether, effects of deuterium on,* should be read *effects of deuterium on formaldehyde yields in radiolysis of ethyl ether* and URANIUM—*crystal structure of, effect of cooling rate on allotropic transformations in,* should be read *effect of cooling rate on allotropic transformations in crystal structure of uranium.*

Special characters are added to modifiers in the fields of physics and reactor technology; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the abstract number.

Physical States and Configurations of Materials

The specific physical state, if other than normal, or the geometric configuration of the material is included in the modifying phrase; e.g., information on liquid metals is indexed under the specific metal with "liquid" in the modifier and carbon crucibles is indexed under CARBON with "crucibles" appropriately placed in the modifier. The information on carbon crucibles is also indexed under CRUCIBLES.

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed to subject headings in the direct form. Cations are listed in the order of increasing valence for polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., SODIUM ALUMINUM SILICATES and POTASSIUM SODIUM SULFATES. If more than one anionic species is presented in a compound, the anions are arranged alphabetically, e.g., BERYLLIUM FLUORIDE HYDROXIDES.

Nomenclature of Organic Compounds

Complex organic compounds occur in such variety as to require a systematic nomenclature. Headings for most substituted organic compounds are found in an inverted form following names of the parent compounds. Examples of two such headings are:

```
2,4-HEPTANEDIONE
2,4-HEPTANEDIONE, 1-PHENYL-
```

Headings are included for broad class names of enzymes, e.g., HYDROLASES and TRANSFERASES. Specific enzyme names are to be found in modifiers under these headings. Similarly, broad class names for hormones are included as headings, except in this case the headings are entered in the inverted form as, e.g., HORMONES, ADRENAL and HORMONES, SEX. The more specific names of hormones are to be found in the modifiers under the appropriate broad headings.

For compounds used as drugs, an effort is made to use subject headings that reflect the recommendations of the USAN (United States Adopted Names) compilation or the "New Names" columns of the *Journal of the American Medical Association.* The *Merck Index* has also been used in selecting subject headings for drugs.

Nomenclature of Life Sciences

Except for those in the phylum Tracheophyta, subject headings for plants are common names. For example, ALGAE, FUNGI, SLIME MOLDS, MOSSES, and LIVERWORTS are subject headings. The phylum name TRACHEOPHYTA and several classes and subclasses belonging to it are entered as subject headings. The specific classes entered are PSILOPSIDA, LYCOPSIDA, SPHENOPSIDA, and PTEROPSIDA. The three subclasses FILICINIDAE, GYMNOSPERMIDAE, and ANGIOSPERMIDAE which belong under Pteropsida are also subject headings. Scientific names (genus and species) and common names if known are used in the modifying phrase.

Subject headings for microorganisms are VIRUSES, RICKETTSIA, and BACTERIA. The name of the type or kind of virus or the genus and species names of the organisms should appear in the modifying phrase.

The names of animal phyla are subject headings. The arthropods are also indexed to subject headings for classes INSECTA, CRUSTACEA, ARACHNIDA, DIPLOPODA, and CHILOPODA. The invertebrate chordates are indexed to subject headings UROCHORDATA and CEPHALOCHORDATA. The vertebrates are indexed to headings for the classes AGNATHA, CHONDRICHTHYES, OSTEICHTHYES, AMPHIBIA, REPTILIA, AVES, and MAMMALIA as well as to the general heading VERTEBRATA. Common names are used as subject headings in the class Mammalia.

Subject headings are entered for various classes of commodities, and specific products are identified in the file-word position of the modifier. In the following examples, approved subject headings are capitalized and typical modifier file words are listed in lower case.

Example 1	Example 2
CEREALS	MEATS
bread	beef
flour	fish
oats	mutton
rice	pork
rye	poultry
wheat	seafood

Diseases, pathological conditions, and in vitro studies of atypical cells and tissues are indexed under subject headings for the organism affected, under the appropriate anatomical structure of physiological phenomenon affected, and under the appropriate disease heading. Subject headings for diseases (defined as any deviation from the norm) are common names such as ANEMIA, FIBROSIS, INFECTIONS, LEUKEMIA, NEOPLASMS, and RADIATION SICKNESS. Also, the general headings DISEASES and DISEASES, PLANTS are available as subject headings.

Multicomponent Alloys and Other Systems

Multicomponent alloys and systems, except those with well-known trade names, are indexed under a subject heading for each component in the form "element systems" for nonmetals or "element alloys and systems" for metals. The modifier begins with element symbols for each component arranged alphabetically. In addition, if significance is placed on the base metal of the alloy, this is indicated by adding "-base" to the element symbol.

Example: A 1.5C, 12Cr, 0.25V, 0.8Mo, bal Fe alloy is indexed as

```
CARBON SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
CHROMIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
IRON ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
MOLYBDENUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
VANADIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
```

Well-known alloys, such as ZIRCALOY-2, are indexed under the trade name; cross references from each component of the alloy to the trade name appear in cumulative indexes.

Multicomponent systems in which nonmetallic elements are present in large percentage and which are commonly referred to as systems or mixtures are indexed in a manner similar to alloys.

Example: A tungsten–silicon preparation is indexed as

```
TUNGSTEN ALLOYS AND SYSTEMS
  Si--W, ...
SILICON SYSTEMS
  Si--W, ...
```

Multicompound systems and mixtures of inorganic compounds are indexed under the subject heading for each component compound; the modifiers begin with an alphabetical listing of compound formulas.

Example: A lead titanate–lead zirconate mixture is indexed as

```
LEAD TITANATES
  PbTiO₃--PbZrO₃
LEAD ZIRCONATES
  PbTiO₃--PbZrO₃
```

Mixtures of organic compounds are indexed under subject headings for each component of the mixture; the modifiers begin with an alphabetical listing of compound names.

Example:

```
ACETIC ACID
  acetic acid--BF₃, ...
BORON FLUORIDES
  acetic acid--BF₃, ...
```

Example:

```
BENZENE, CHLORO-
  bromophenol--chlorobenzene, ...
PHENOL, BROMO-
  bromophenol--chlorobenzene, ...
```

A mixed system of compounds and elements is indexed by a combined form of the preceding conventions; e.g., a dispersion of copper and alumina would be indexed as

```
ALUMINUM OXIDES
  Al₂O₃--Cu, ...
COPPER ALLOYS AND SYSTEMS
  Al₂O₃--Cu, ...
```

If modifiers for alloys and systems are included with other modifiers under the same subject heading, they are filed last.

Example:

```
CARBON SYSTEMS
  deposition on nuclear fuel
    particles
  molecular structure of
  neutron total cross section for
  sorptive properties for xenon
  Young's modulus for
  Al--C--Cr, superconductivity in
  B--C, phase studies for
  C--U--Zr, fabrication and
    physical properties of
```

Nomenclature of High Energy Physics

Information on particle-particle events is indexed under subject headings for the specific particles involved. The modifier file word *interactions* is followed by the specific interaction written in symbolic form. Particle nomenclature and symbols follow that of the Particle Data Group published in *Review of Particle Properties* (latest revision). For consistency the incident particle is always written first. The mass (in MeV) of a resonance state is included in parentheses after the symbol to avoid ambiguity. Hyperfragments are indicated in modifiers as in the following examples: $\Lambda\text{-He}^5$, $\Sigma\text{-H}^3$, $\Lambda\Lambda\text{-Be}^{10}$. The superscript on the right indicates the total number of baryons in the composite system.

Examples:

```
MESONS (π⁻)
  interactions π⁻ + p → Λ + K⁺ + π⁻ at 6 GeV/c in
    hydrogen bubble chamber, ΛK(1700) enhancement
    in, (E)
BARYONS, RESONANCE (Δ)
  production of Δ⁺⁺(1236) and Δ⁰(1236) from K⁻ +
    p → K⁻ + p + π⁺ + π⁻ interactions at 2.63 and
    2.70 GeV/c, (E)
HYPERNUCLEI
  binding energy of ΛΛ-He⁶, three-body α--Λ--Λ
    model for
```

Subject headings are also provided for specific models and theories.

Examples:

```
ELEMENTARY PARTICLE MODELS
  quark, hadron total cross sections in,
    numerical analysis of
CURRENT ALGEBRA
  PCAC hypothesis for A₁ and rho dominance in π →
    e + ν + γ decay
REGGE POLE THEORY
  predictions for polarization in K⁻ + p → anti
    K⁰ + n, π⁻ + p → π⁰ + n, and π⁻ + p → eta + n
    interactions at high energies
SYMMETRY GROUPS
  SU(2) x SU(4) intermediate-coupling model for
    nucleon and hyperon isobars
```

Nomenclature of Reactor Technology

Subject headings for reactors are of three types:

(1) Specific reactors, e.g., ARGONNE RESEARCH REACTOR, SAXTON POWER REACTOR

(2) Reactors having a common physics or engineering characteristic, e.g., REACTORS, FAST; REACTORS, ORGANIC-COOLED; REACTORS, PRESSURIZED-WATER

(3) Reactors having a common purpose, e.g., REACTORS, POWER; REACTORS, RESEARCH

Information on specific reactors, type (1), is indexed under the one specific subject heading. Information on classes or types of reactors, types (2) (characteristics) and (3) (purpose), is indexed under all applicable headings. For example, information on a heavy-water-moderated organic-cooled power reactor is indexed under REACTORS, HEAVY WATER-MODERATED; REACTORS, ORGANIC-COOLED; and REACTORS, POWER.

Subject headings exist for selected reactor components, e.g., REACTOR FUEL ELEMENTS. When applicable, headings for components are indexed even though they may have been included in a modifier under a type (2) or (3) heading. The materials in reactor components are indexed when the information is peculiar to the material.

Modifier file words under reactor headings are of two primary types: one type expresses reactor characteristics, e.g., reactivity; the other, components, e.g., control rod. If no subject heading appears for a reactor component, the heading REACTORS is used, and the component is used as the modifier file word.

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CONF-711121-	(10th Japan Conference on Radioisotopes, Tokyo, Japan, Nov. 16-18, 1971)	
2	26-50324	Dep. NTIS, 23p.
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1	26-52483	See COO-4217-1
CONF-711213-	(Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry, Vienna, Austria, Dec. 13-17, 1971)	
2	26-50617	See CEA-CONF-1982
CONF-720116-	(Informal Conference on Polly and Polly-like Devices, Argonne, Il., Jan. 11-12, 1972)	
1	26-50696	See COO-1195-228

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CONF-720206-	(International Conference on Inclusive Interactions, Davis, Ca., Feb. 4-5, 1972)	
4	26-51814	See SLAC-PUB-1033
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12	26-51759	See SLAC-PUB-1058
13	26-50699	See SLAC-PUB-1056
CONF-720419-	(4th International Conference on High Energy Collisions, Oxford, England, Apr. 5-7, 1972)	
2	26-51666	See SLAC-PUB-1039
CONF-720423-	(1st European Conference on Computational Physics, Geneva, Switzerland, Apr. 10-14, 1972)	
3	26-52263	See CEA-CONF-2012
CONF-720439-	(International Conference on the Chemical Arts, Paris, France, Apr. 20-21, 1972)	
1	26-52401	See CEA-CONF-1997
CONF-720442-	(Executive Conference on Nuclear Standards, Monterey, CA., Apr. 30-May 2, 1972)	
1	26-52410	See ORNL-TM-3842
CONF-720521-	(State Radiological Health Personnel Meeting, Oak Ridge, TN., May 30, 1972)	
1	26-50436	Dep. NTIS, 38p.
CONF-720544-	(Excerpta Medica International Symposium, London, England, May 8, 1972)	
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CONF-720607-	(18th Annual American Nuclear Society Conference, Las Vegas, NV., June 18-22, 1972)	
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CONF-720614-	(17th Annual Meeting of the Health Physics Society, Las Vegas, NV., June 12-16, 1972)	
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CONF-720623-	(Symposium on Modern Methods in the Study of Microbial Ecology, Uppsala, Sweden, June 19-23, 1972)	
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CONF-720632-	(IUCRM Colloquium, San Diego, CA., June 5-16, 1972)	
1	26-52718	Dep. NTIS, 32p.
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1	26-52700	See BNWL-SA-4352
CONF-720644-	(Sub-LF Downlink Satellite Communications Conference, Washington, D.C., June 6-9, 1972)	
1	26-51414	See LA-DC-72-746
CONF-720707-	(Annual Conference on Nuclear and Space Radiation Effects, Seattle, WA., July 24-27, 1972)	
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9	26-52223	See SC-DC-721144
11	26-52878	See UCRL-73796
12	26-52252	See UCRL-73826
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5	26-50609	See BNWL-SA-4330
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CONF-720823-	(12th Air Cleaning Conference, Oak Ridge, TN., Aug. 28-31, 1972)	
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3	26-50553	See ARH-SA-137
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7	26-50559	See UCRL-73815
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CONF-720909-	(General Discussion on the Photoelectron Spectroscopy of Molecules, Brighton, England, Sept. 12-14, 1972)	
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